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July, 1912.

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The Foremost Authority on the Resources of the Philippine Islands.
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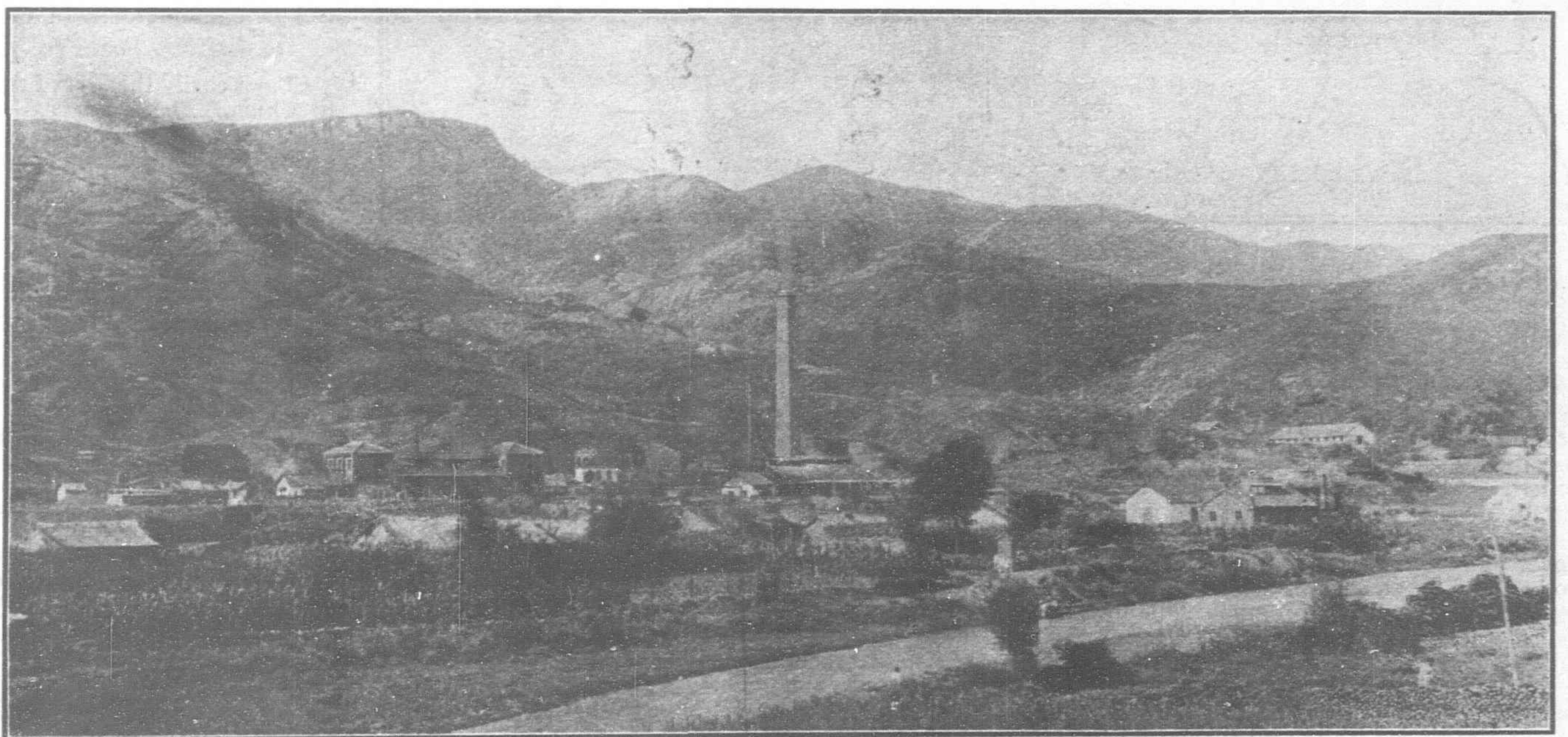
VOL. IX.

SHANGHAI AND MANILA, JULY, 1912

No. 2.

THE MINERAL PRODUCTION AND RESOURCES OF CHINA*

BY THOMAS T. READ,† SAN FRANCISCO, CAL.



GENERAL VIEW OF THE PENCHIHU COLLIERY, LOCATED AT PENCHIHU, ON THE LINE OF THE ANTUNG-MUKDEN RAILWAY, MANCHURIA.
UNDER JOINT CHINESE AND JAPANESE MANAGEMENT. OKURA & CO., GENERAL MANAGERS.

I. INTRODUCTION.

When so much has been written upon a subject on which so little definite information is available as upon this, some reason must needs be assigned for adding to the volume of literature. A sufficient reason is found in the probable great future importance of China as a producer of mineral wealth. The present undeveloped state of mining in the country is due to many causes, among which the most important are the relatively simple needs of the population, the lack of transportation facilities, the inelastic regulations governing the industry, and the superstitious reluctance of the people to make excavations which might disturb the spirits of the earth and air, or of ancestors.

Iron is the metal most in demand, yet the needs of the population, until recently, only made necessary a production of approximately 0.5 lb. of iron per capita per year. The present annual production of iron for domestic consumption, in the United States, is nearly 600 lb. per capita. The curious state of development of transportation in this interesting country has been a greater handicap upon the mining industry than upon any other. The point

upon which it hinges is the absence of a road-system. Except for a few military roads, now almost impassable, there are no roads in China; that is to say, there is no land which is set aside as a right of way, belonging to the commonwealth. Throughout the agricultural districts, generally speaking, the entire area is in private ownership, and the lines of travel are between fields. There is a constant struggle for existence between the owners of the land and the travelling public, with the natural result that the so-called roads usually are simply lines along which it is merely possible to travel. Most merchandise is carried in baskets over the shoulder, pushed in wheelbarrows, or transported on pack-animals, to the nearest stream. Really cheap and efficient transportation is confined to the rivers, and great ingenuity is exhibited in utilizing them to the fullest extent. On the Lan river, for example, the boats, to use an expressive colloquialism, "can float in a heavy dew." The regions where mineral wealth is abundant are naturally but poorly supplied with navigable streams, and it is only where Nature has been so kind as to gather together in one place all the materials necessary for the extraction and reduction of the minerals that any considerable industry has been able to develop. Now railroads are penetrating all parts of the country, the streets built in the cities are being extended as roads through the surrounding territory,

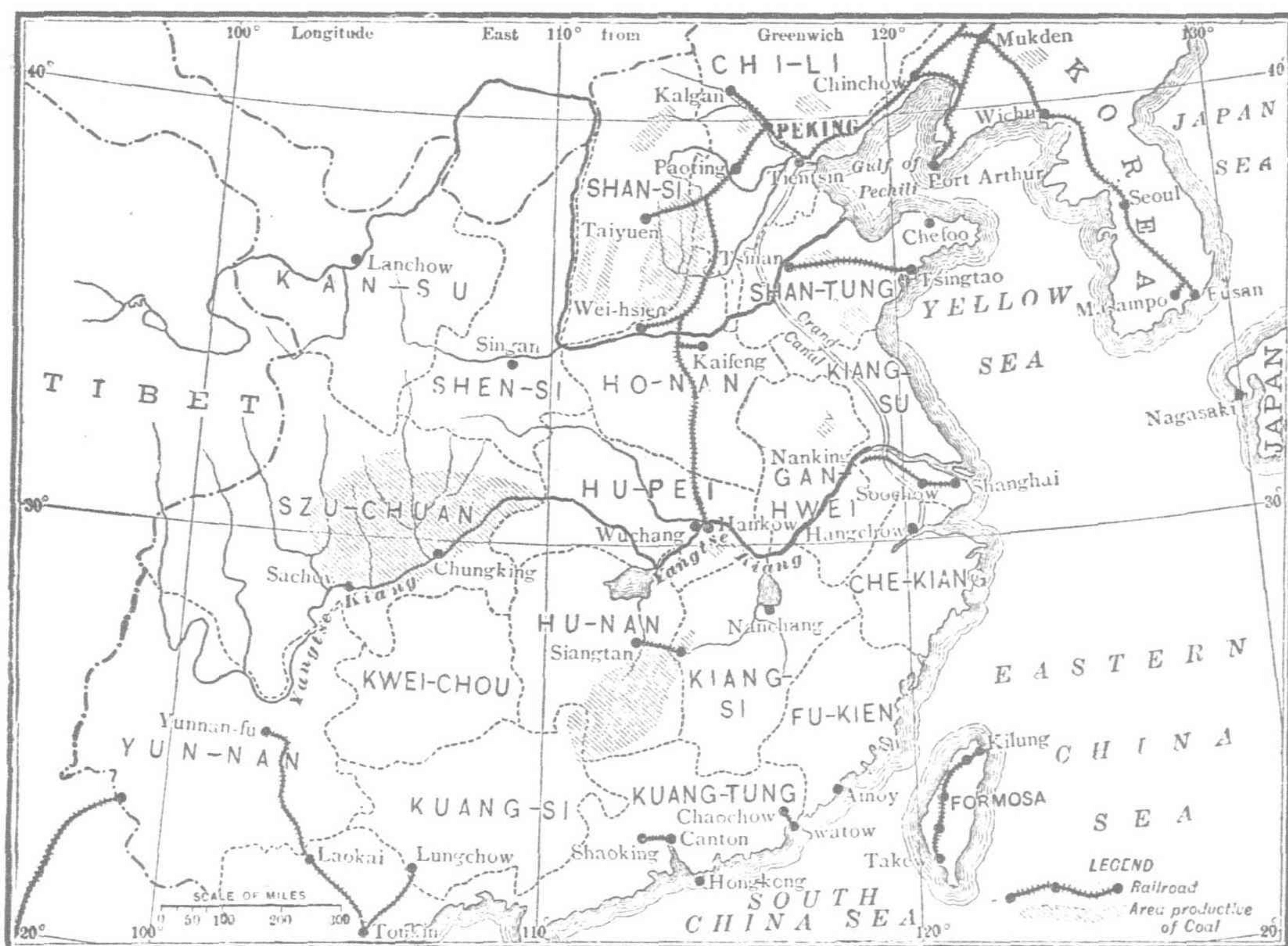
and the mineral industry is taking on a new aspect.

Theoretically the mineral wealth of the country is the property of the central government, and is only worked by permission upon a royalty basis. Practically this is difficult to enforce, and there have grown up relationships between the operators and the government which are complicated in the extreme. The development of the mining industry is correspondingly hampered, and it is to be hoped that a simple and direct code of mining-regulations may be put in force at no far distant date. The importance of the superstitions regarding graves and "Feng-Shui" has been over-emphasized. It has undoubtedly operated to restrict prospecting-work, but where valuable deposits are found it is always possible to have graves moved for a reasonable sum, and it is but seldom that a regard for "spirits" is allowed to operate to financial disadvantage. With the spread of education this factor will lose the limited importance it now possesses.

Easily first in the mineral wealth of China are coal and iron. Willis⁵⁴ (reference is to bibliography given at the end of this paper) has estimated that the anthracite-resources of Shansi and adjacent territory are equal to those of Pennsylvania, and while no estimate is possible of the total amount of bituminous coal, it is safe to say that it is also comparable

* Paper read at the Annual Meeting of the American Institute of Mining Engineers.

† Formerly Professor of Metallurgy, Imperial Pei-Yang University, Tientsin, China.



MAP OF CHINA, SHOWING COAL AREAS

with that of the United States. It is impossible as yet to estimate the iron-resources, for reasons given under the discussion of that metal, but there is every reason to believe that they are extensive and valuable: some progress has already been made in their utilization on a modern scale. The country is the most important producer of antimony, and ranks high in the production of tin. The production of copper and zinc is already appreciable, and the production of petroleum, while as yet small, seems to have much of promise. The production of gold, silver, mercury, and other metals, while worthy of notice, seems to offer less hope of great increase by the introduction of improved methods of working. It will be evident from the following pages that the mineral production of China is at present of no little importance, and her known resources are great enough to offer ground for the belief that considerable development can be expected in the future.

During three years of residence in North China, I visited a large number of districts of which the mineral production is now considerable. It was not possible, of course, to visit all, and for the extreme south and southwestern parts of the country, have been dependent upon the statements of others, but especially upon published reports of the notable group of French explorers and engineers who have extended their study of Indo-China to cover the adjacent areas. The report of Duclos,¹³ and that of LeClere,²⁵ are especially important. Richthofen's monumental work⁴⁴ is of permanent value, as is that of the Carnegie Institution exploring party.⁵³ The latter deals only with general geology, but is of great interest as marking the first attempt to carry on topographic and geologic surveys in China with the precision attained in the United States. A very important paper is that of Willis,⁵⁴ who has made an admirable summary of the literature bearing upon the mineral resources of the Chinese country.

The bibliography which concludes this paper is not complete, nor has any effort been made to include all references to the subject. All the more important papers are included, but if any have escaped attention the correction will be welcome. Those who have carried on investigation in the Orient will appreciate the difficulty of the work. Important papers have been published in journals that are difficult or impossible to obtain, the native reports are

entirely unreliable, and many areas of importance have never been adequately described. In addition, there is much conflict between reports upon a single area, and often complete disagreement between figures as to present production. The following represents merely as close an approximation to the truth as now seems possible, and will require extensive revision in the light of future development. But having acquired, with much effort, an imperfect knowledge of the mineral resources of this great country, it appears a professional duty to place it in a form which may be of assistance to later workers in this broad field. Erroneous statements have probably been included, and it is hoped that the many

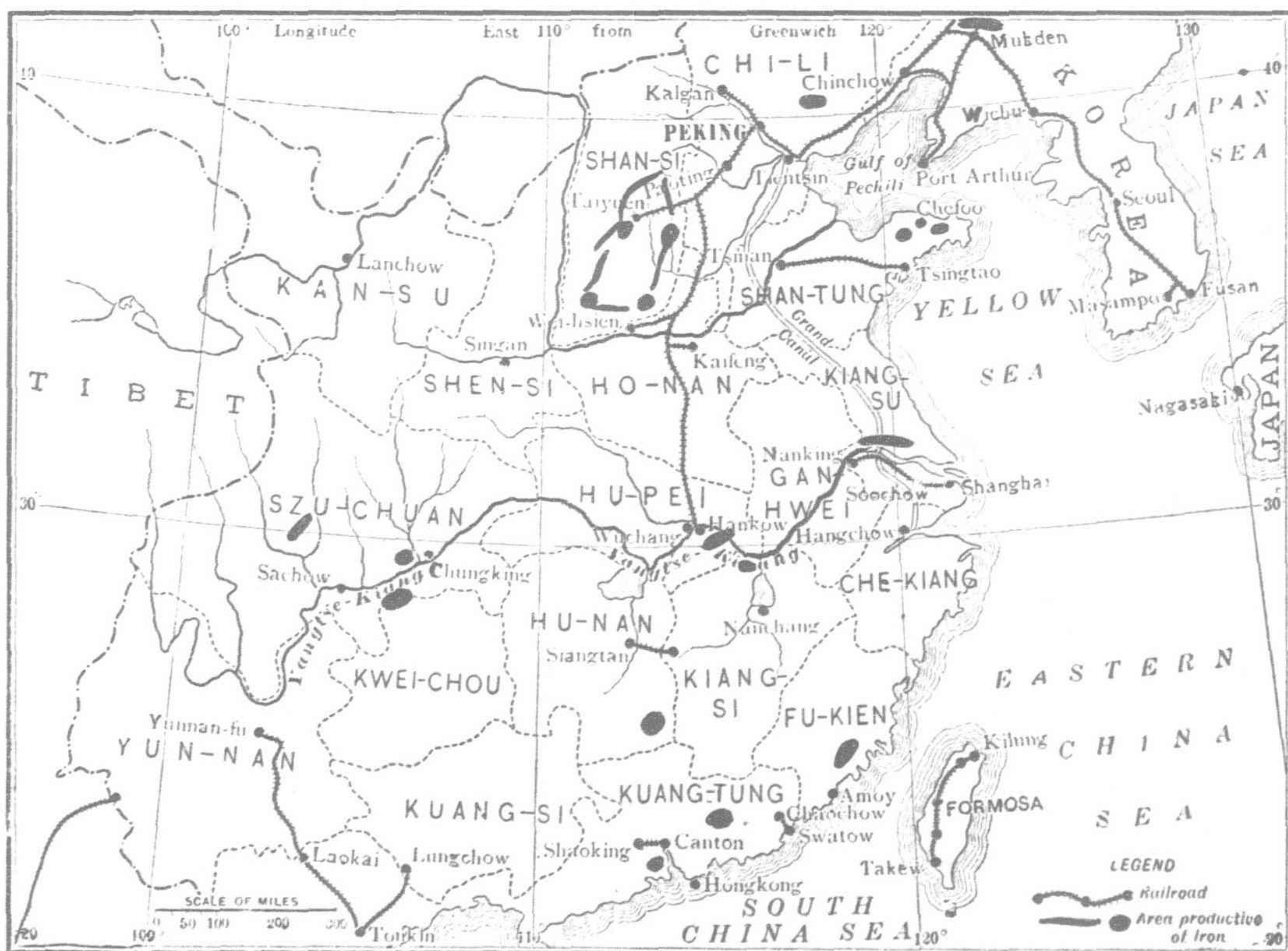
engineers who have visited China will contribute further data.

In quoting from the reports of others the almost insurmountable obstacle of identification of place-names is constantly met. This is especially true of the French and German authors, whose spellings are often unrecognizable. Wherever possible I have given the latitude and longitude of the localities mentioned, except in the case of well-known places. Even this is unsatisfactory, for the most accessible accurate maps of south-western China are French and the longitude is given in degrees east of Paris, which is approximately 2° 20' east Greenwich. The French notation has been followed in the case of points in Ssu-chuan, Yunnan, and Kweichow. This should be borne in mind in consulting the maps. In some cases where the spelling is obviously incorrect, or it has been impossible to identify the places, I have placed them within a semi-quotation mark 'thus,' and turned over the difficulty to the reader.

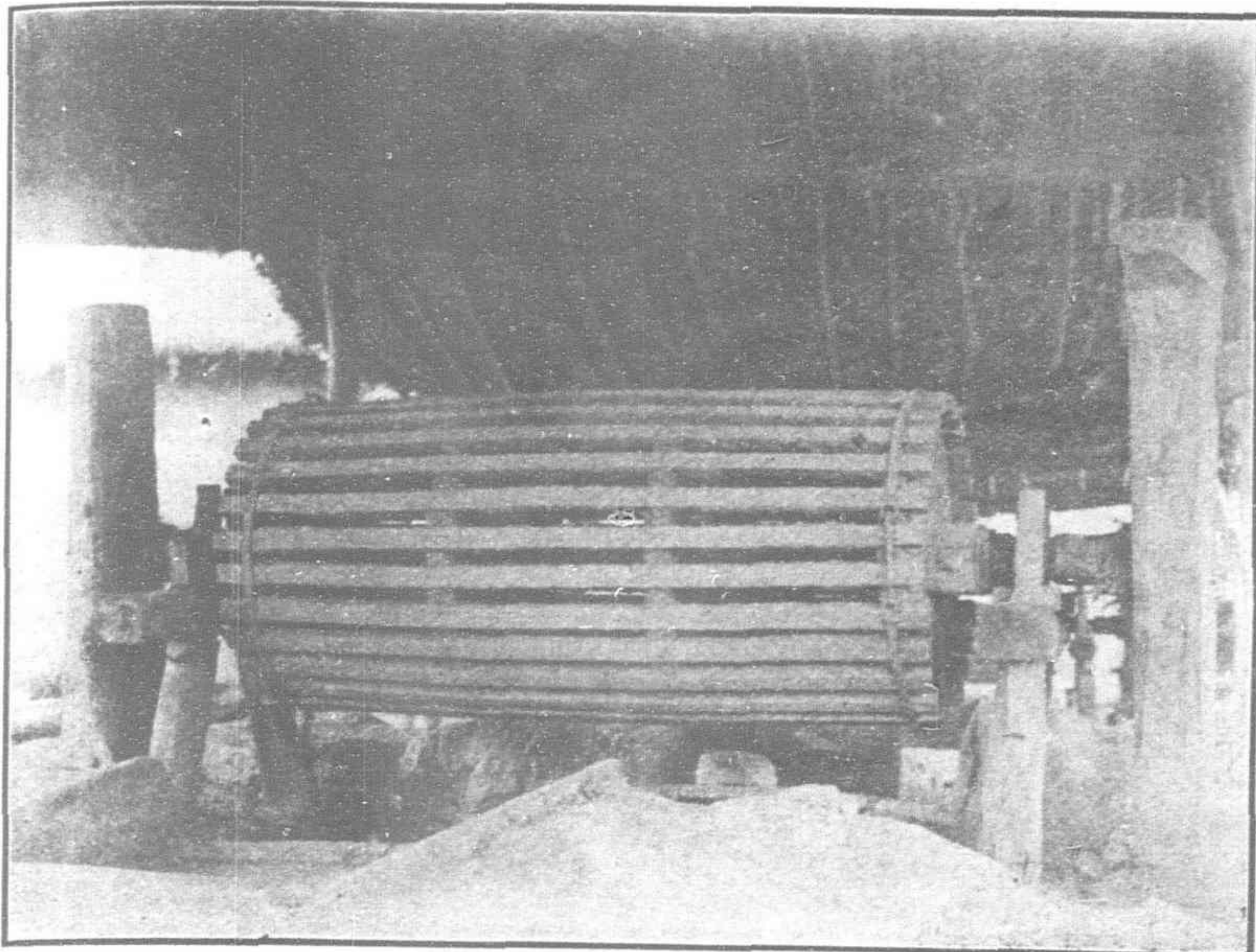
For convenience, reference is made by number in the text to the bibliography, given at the end of the paper; ⁴³ is a good geography of the country and ⁸ is a fairly complete bibliography of China.

II. COAL.

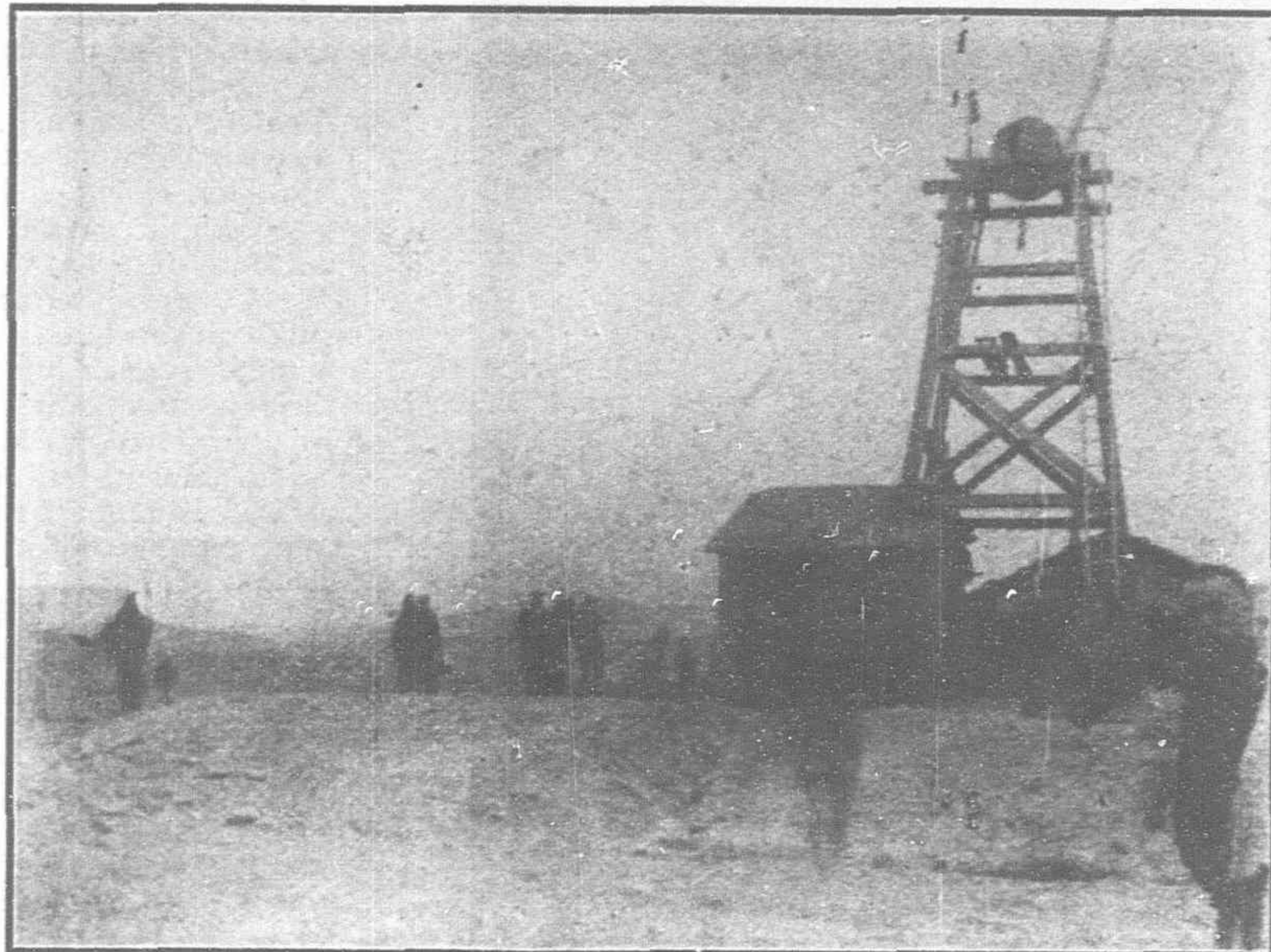
Coal is easily the first of the mineral resources of China. The great extent of the deposits has already been indicated and a conservative estimate of the present production is 15,000,000 tons annually. The casual visitor to North China, where the winter climate is rigorous, seeing the children of the villagers, armed with rake and basket, engaged in collecting every scrap of vegetable material that can be utilized as fuel, is likely to wonder why coal is not more generally used. The reason is not recalcitrant: the low cost of labour, the high cost of transportation, and the low scale of living put coal beyond the reach of the population in many regions. It is probably safe to estimate that one-half the cost of the food of an ordinary workman is chargeable to the fuel used in cooking it, and where the otherwise unemployed children can be sent out to gather grass and pull up the roots of the larger cereals, such as corn and *kao-liang*, there is little market for coal, except for industrial purposes. Near the mines, where coal is abundant and cheap, it is freely employed. The development of railroads, steamships and industrial plants will not only create a greater



MAP OF CENTRAL CHINA, SHOWING IRON-ORE CENTERS



HAND WINDING APPARATUS

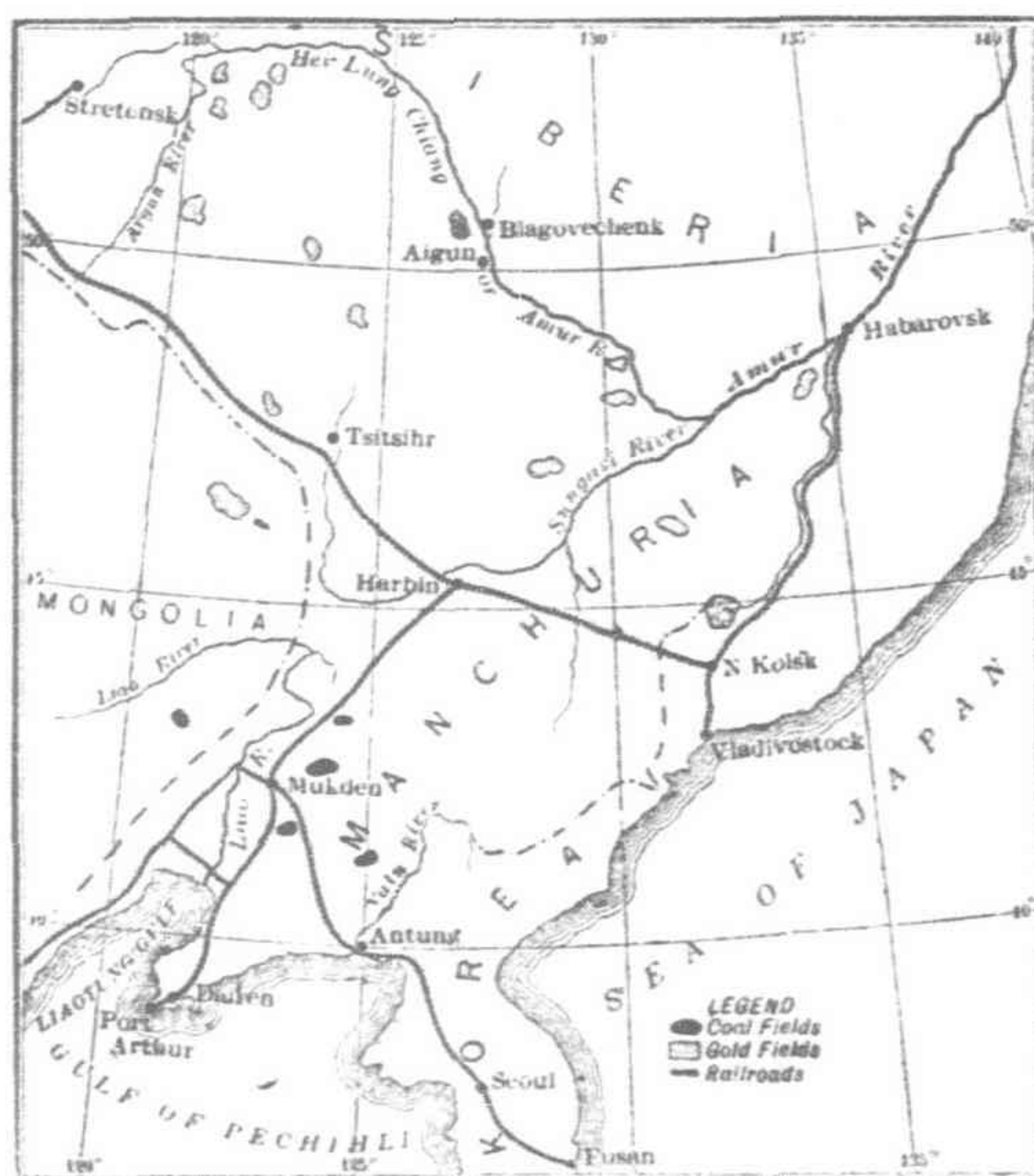


HEAD GEAR AT NATIVE MINE

market for coal, *per se*, but, by raising the scale of living through the higher wages paid for labour, will increase the consumption of coal for household purposes. The annual consumption of coal in the United States is approximately 3.5 tons per capita per annum; the consumption in China is approximately 1/25 ton per capita per annum. An approximate estimate of the present coal-production in China is given in Table I.

TABLE I.—*Approximate Estimate of the Present Coal-Production of China.*

Province	Anthracite	Bituminous	Sub-Bituminous and Lignite
	Tons	Tons	Tons
Manchuria		25,000	1,000,000
Chihli	840,000	2,090,000	150,000
Shansi	4,000,000	25,000	
Shensi		500,000	
Kansu		500,000	
Shantung	300,000	500,000	
Honan	1,000,000		
Ssu-chuan		500,000	
Kweichow		250,000	
Yunnan		300,000	
Chekiang		10,000	
Kiangsi		700,000	
Hunan		200,000	
Kuangtung		50,000	
Kuang-i		100,000	
Other provinces		100,000	
Total.....	6,110,000 5,900,000 1,150,000	5,900,000	1,150,000
Grand total...	13,190,000		



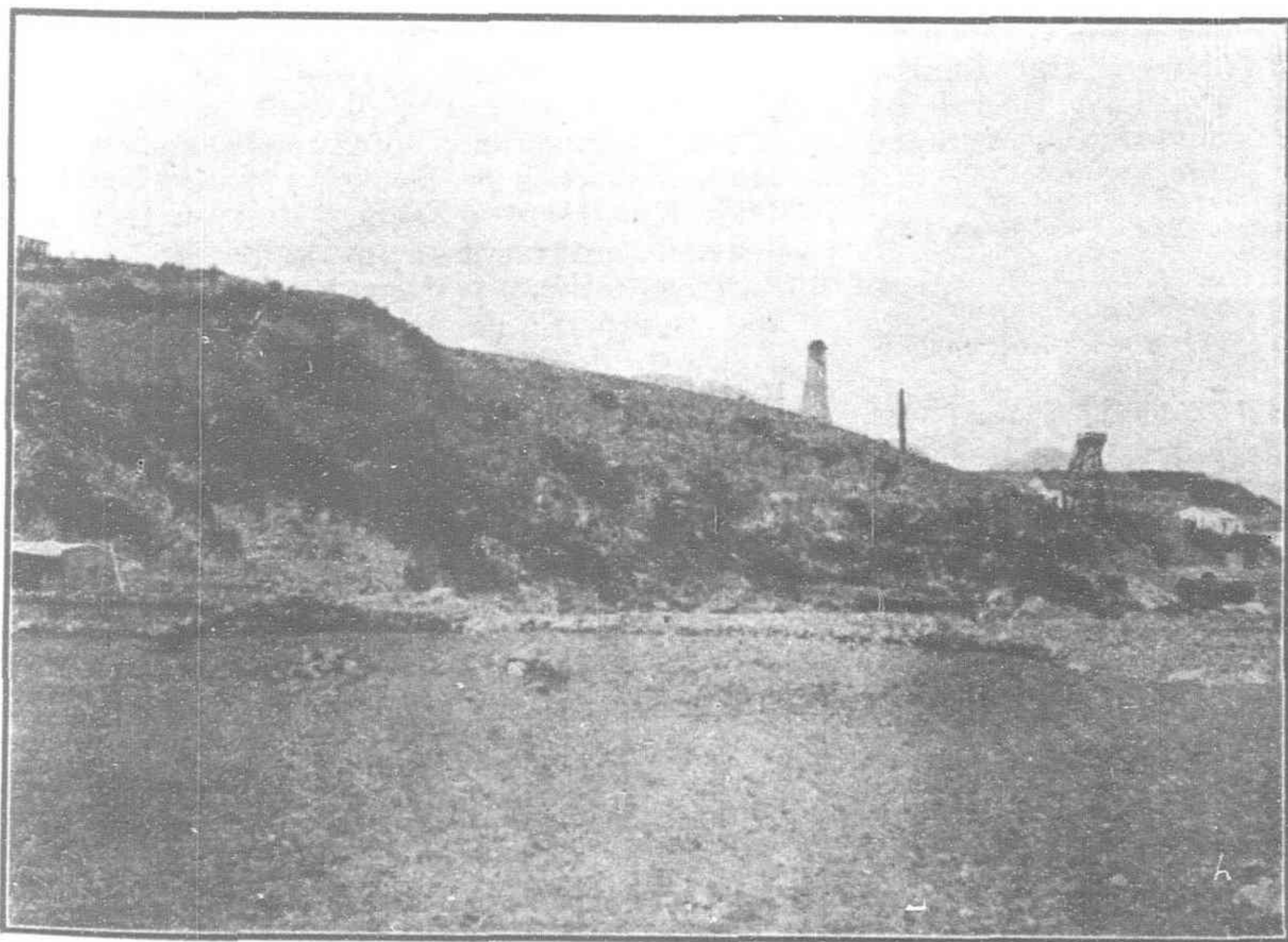
COAL FIELDS AND GOLD FIELDS
OF MANCHURIA
(After Purlington)

The sketch-map, Fig. 1, shows in general the coal areas of China. This map, as well as Fig. 2, has some misspelled names, as it was impossible to arrange for revision of the proofs.

The coals of China are as varied in quality as those of the United States, but this difference should be noted: the amount of lignite is comparatively small, and the proportion of anthracite to bituminous is relatively larger than in the United States. As previously noted, Willis has estimated that the anthracite-resources of Shansi and the adjacent fields are practically equal to those of Pennsylvania. If this is in error it is probably upon the safe side, and the total coal-resources of the Chinese country seem likely, upon careful mapping, to compare favourably with those of the United States.

In the space at my command it would not be possible to give more than a brief outline of each of the important fields. The number of fields is so great that an attempt at classification would lead to too great complexities, and it will be simplest to consider them briefly by provinces.

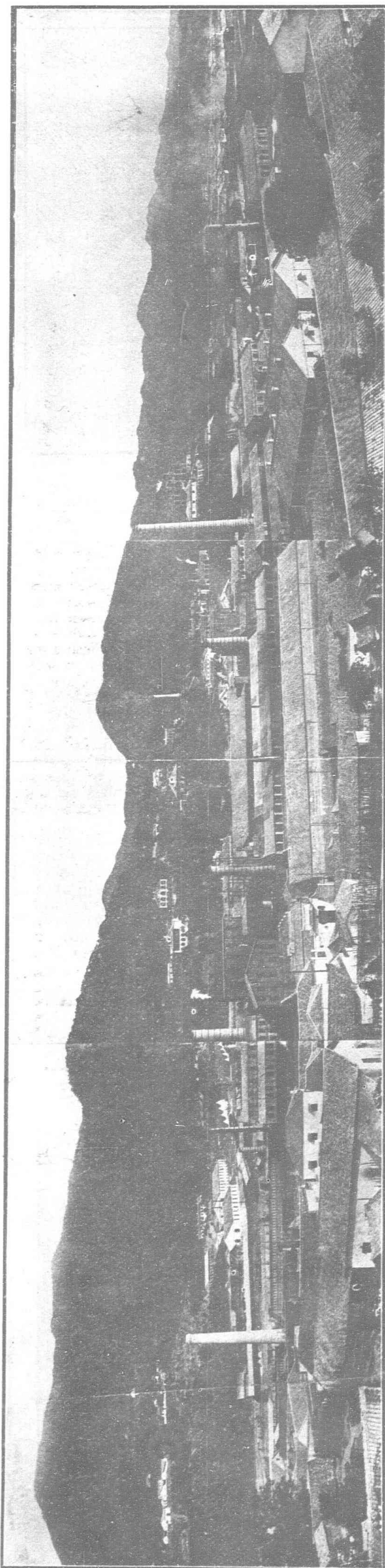
In Manchuria one large mine is now in operation at Fushun. This field, seen just above the word "Mukden" on the sketch map, has been described in detail, ³⁸, ³⁹, so nothing further will be given here than to state that the coal is a sub-bituminous of excellent quality. The mines, owned and operated by the South



MENTAKOU COAL MINE, NEAR PEKING



HEADFRAME OF NO. 2 AND 3 SHAFTS, TANGSHAN MINE



GENERAL VIEW OF THE PINGHSIANG COLLIERY

Manchuria railway, had a production in 1910 of 830,328 tons, and are expected to reach 1,000,000 tons per year when the second of the two pairs of deep shafts (18 and 20 ft. in diameter) are in full working-order. More recently the mines at Pen-hsi-hu, on the Antung-Mukden railway, have been developed; but, although I passed through the town in the autumn of 1910, I have been unable to obtain figures as to the production, which is probably small as yet, but is likely to develop when the standard-gauge line between Mukden and Antung is in operation. The chief engineer at Fushun stated in 1909 that the Pen-hsi-hu coal is a friable semi-bituminous, occurring in Jurassic strata, and not of especially good grade, but more extensive development may have disclosed seams of better quality. The same remarks will apply to Sai-ma-chi (125° E., 41° 30' N.); owing to its distance from the railroad no very serious attempts have been made to develop these mines. All mines in the South Manchuria railway zone are to be developed jointly by Japanese and Chinese.

Just east of Kwan-cheng-tze (125° E., 44° N.), coal similar to that at Fushun occurs in several places, and though the attempts at working have not been very successful as yet, the seams at this place are likely to become of great importance, as the branch railroad to Kirm cuts directly across them. West of the Liao river (somewhere about 122° E., 43° N.) a valuable and important field is said to exist, but I have not visited the locality and have no definite knowledge of it. Some time since the Imperial Railways of North China attempted to exploit some seams of a true lignite a short distance north of the Great Wall, but they proved to be of too poor quality. Other localities where coal occurs are Yentai and Wu-hu-tsui, but the production is unimportant. Thin seams of coal can be seen in the cuts along the trans-Siberian railroad, and the Bureau of Mines for Manchuria has published a long list of places where coal occurs in Manchuria. The coals of the southern part of the province were described by K. Inouye in 1905.²⁰ Coal occurs widely throughout the area; that at Fushun and near Kwan-cheng-tze is sub-bituminous and of Tertiary age; in the other districts the coal is semi-bituminous and of Jurassic age. No closer classification can be attempted as yet. The native consumption is generally supplied by small local mines. The South Manchuria railway and a considerable portion of the shipping-trade of Dalny (Tairen) are supplied by the Fushun mines. As the workable coal in the Fushun field has been estimated at 800,000,000 tons, Manchuria is well supplied with coal. But the Manchurian coals are very friable, furnishing but a small proportion of lump-size, and no good coking-coal has yet been found. The composition of the coals of Manchuria is given in Table II.

Chihli, which immediately adjoins Manchuria on the southwest and is the metropolitan province, is now the most important producer of coal, as can be seen from Table III, which gives a summary of the coal-output of Chihli province for 1909 by K. Y. Kwong, chief mining engineer for the Chihli Province Bureau of Mines, Tientsin. The composition of some Chihli coals is given in Table IV.

TABLE III.—Production of Coal in Chihli Province for 1909, Lignite.

	Tons.
Jehol district (118° E., 41° N.) coal-fields.....	150,000
Yen-pao-shan	
Wo-chia-tze,	
Shih-t'ou-fen,	
Total lignite.....	150,000

TABLE II.—Analyses of Manchurian Coals.

No.	Locality.	Moisture.	Volatiles Hydrocarbon.	Fixed Carbon.	Ash.	Sulphur.	Analyst.	Remarks.
		Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.		
1	Fu-shun.....	6.30	39.34	52.90	3.18	0.27	C. H. Wang Geological Survey of Japan.	Average of 7 published analyses.
2	Fu-shun.....	4.43	40.33	48.89	6.35	1.00		
3	Wu-hu-tsui...	2.70	11.42	76.69	9.19	0.50		
4	Pen-hsi-hu...	0.96	21.66	66.06	11.32	0.84		
5	Yen-t'ai.....	1.07	14.22	74.98	9.75	0.66		
6	Sai-ma-chi...	1.39	25.54	60.47	12.25	0.80		
								Average of 3 published analyses.
								Average of 3 published analyses.
								Average of 3 published analyses.

Anthracite Coal.

Kin-Han railway district coal-fields.....	Tai-an, Fangshan-hsien(116° E., 39° 45' N.), Sha-ho-hsien(114° 40' E., 37° N.), Lin-ming-kwan, Han-tan-hsien,	600,000
Peking-Shan haikwan railway district coal-field,	Shi-men-tsai,	5,000
Peking-Kalgan railway district coal-fields.....	Sin-pao-an.....	20,000
	Peking Western Hills (115° 45' E., 40° 15' N.),	150,000
Total anthracite.....		840,000

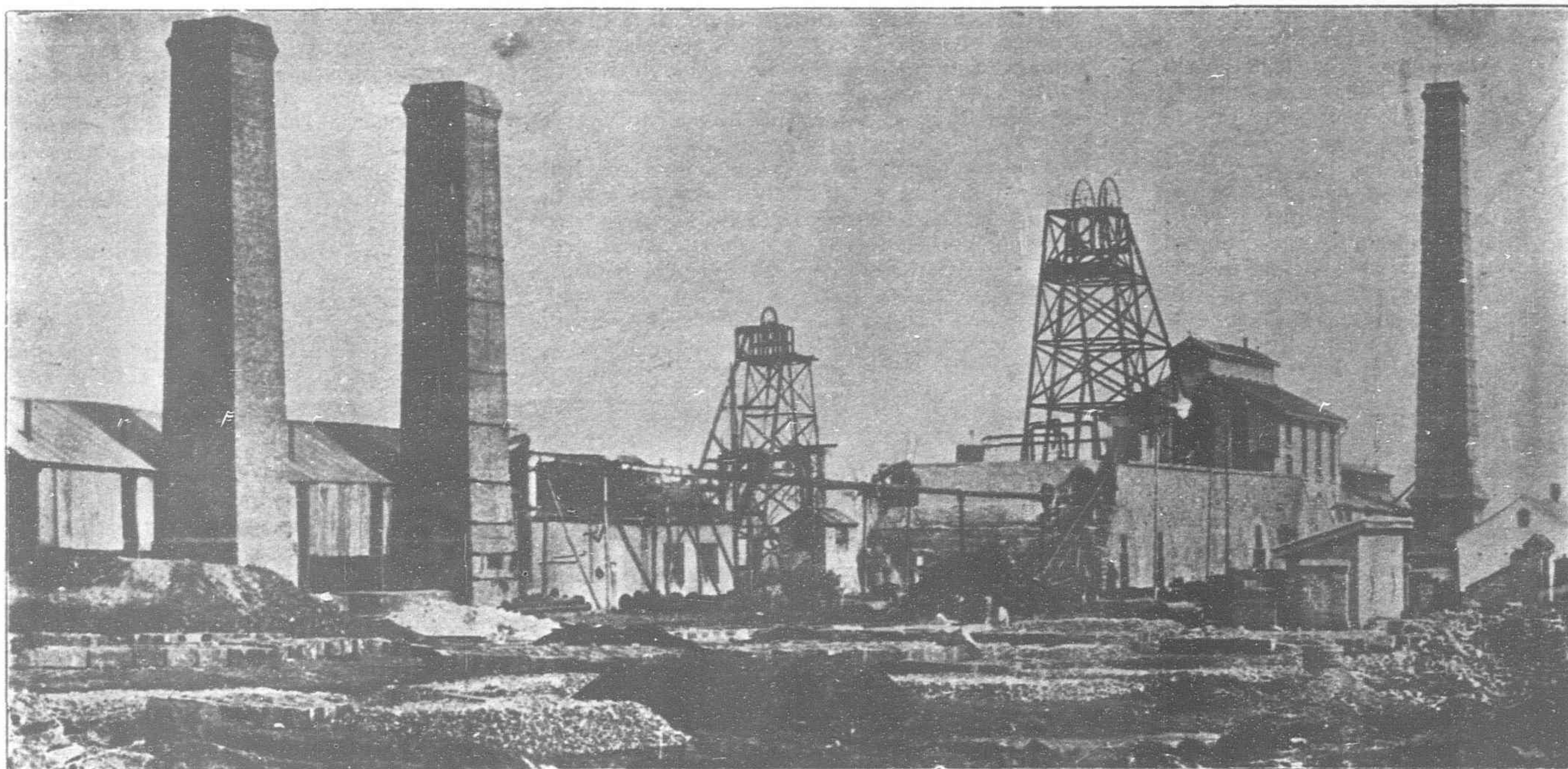
Bituminous Coal.

Peking-Shan haikwan railway district coal-fields.....	Kaiping { C.E. & M. Co., Ltd., mines, Linchow mines,	1,400,000
Kin-Han railway district coal-fields.....	Lingshan.....	50,000
	Ching-hsing (114° E., 38° N.),	160,000
	Lincheng(114° 30' E., 37° 30' N.),	100,000
	Tze-chow (114° 20' E., 36° 30' N.),	100,000
Peking-Kalgan railway district coal-fields.....	Hsuen-hua-fu (115° 10' E., 40° 50' N.),	40,000
Lan-Ho and Jehol districts coal-fields.....		100,000
Chow-yang-fu coal-fields.....		140,000
Total bituminous coal.....		2,090,000

TABLE IV.—Analyses of Some Chihli Coals.

No.	Locality.	Moisture.		Ash.		Fixed Carbon.		Volatiles Hydrocarbon.		Sulphur.		Analyst.	Remarks.
		Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.		
1	Tongshan, C.E. & M. Co.	1.00	16.67	18.02	56.78	23.95	25.55	1.01	1.46	2.22	2.38	C.H. Wang.	Coking, bituminous.
2	Tongshan, C.E. & M. Co.	0.84	16.67	18.02	56.78	23.95	25.55	1.01	1.46	2.22	2.38	C.H. Wang.	Bituminous.
3	Tongshan, C.E. & M. Co.	1.37	21.72	18.59	53.81	23.10	23.10	2.55	2.55	2.33	2.33	C.H. Wang.	Non-coking, bituminous.
4	Tongshan, C.E. & M. Co.	0.93	12.29	13.55	59.75	27.03	27.03	3.90	3.90	2.21	2.21	C.H. Wang.	Coking, bituminous.
5	Tongshan, C.E. & M. Co.	0.90	13.55	18.59	70.33	15.22	15.22	2.26	2.26	4.62	4.62	C.H. Wang.	Coking, bituminous.
6	Tongshan, C.E. & M. Co.	0.77	18.59	18.59	53.28	27.49	27.49	1.11	1.11	.....	.....	Average of company analyses.	Analysis furnished by company.
7	Linsai, C. E. & M. Co.	0.77	19.18	19.18	51.97	28.05	28.05	0.88	0.88	.....	.....	Average of company analyses.	Analysis furnished by company.
8	Ching-Hsing.....	0.54	13.49	13.49	61.16	24.81	24.81	2.26	2.26	2.46	2.46	C.H. Wang.	Coking, bituminous.
9	Chai-t'ang.....	2.11	6.67	6.67	68.23	22.99	22.99	0.19	0.19	2.97	2.97	C.H. Wang.	Non-coking, bituminous.
10	114° 30' E., 38° 45' N.....	1.20	12.97	12.97	80.50	5.43	5.43	0.97	0.97	14.81	14.81	C.H. Wang.	Hard, dry anthracite.

The lignite and bituminous coal of the Jehol district is produced by native methods. The Kin-Han (Peking-Hankow) railway district anthracite-field and the Peking-Kalgan railway district held are northern and southern portions of one field lying a short distance west of Peking. Hoover¹⁷ and Woo⁵⁶ have described the Chinese



THE PEKING SYNDICATE COAL MINES, HONAN

Engineering & Mining Co. mines at Tongshan and Linsi in detail. These are the largest and most important coal-mines in China. They are owned by an English company, but it has been proposed by the gentry of the province that the concession be purchased by the Provincial government. Since the descriptions were written, the mines have been much developed and improved. They produce nearly all of the total of the 1,400,000 tons estimated above, as the semi-official Lanchow mines, in the same field, have only recently been started and, though well equipped, seem unable to operate at a profit. The net profit of the Chinese Engineering & Mining Co. mines for the year ending February, 1910, is given as £243,300. The Ching-Hsing mines, on the railroad Tai-yuan-fu, are worked under German supervision, and have both Chinese and German capital. The production in 1910 was 150,000 tons. The Lincheng mines are operated to supply the Kin-Han railway with fuel, and are under the supervision of K. Y. Kwong. They have an output of 800 tons per day. The coal-field at Tze-chou has been described by Drake¹⁰. The mines at Hsuen-hua-fu have only recently been opened to supply the Peking-Kalgan railway with fuel, and their production will probably increase considerably during the next few years; there is already a considerable production by native methods in this and adjacent districts. It is obvious that it would be possible to devote much space to a description of the mines of this one province, but they are so accessible and comparatively well known that, in spite of their great importance, I shall not discuss them further. The analyses in Table IV. show the characteristics of these coals, and it will at once be noticed that they grade by degrees from bituminous into anthracite.

In Shantung coal occurs in many places, but the larger part of the production comes from the mines owned by the Shantung Bergbau Gesellschaft, at Po-shan (118° 0' E., 36° 45' N.) and Fang-tze; 252,816 tons of anthracite coal having been produced at the former place in 1910, and 230,064 tons of bituminous at the latter. These mines have washing-plants. Some difficulty has been found in working, owing to faulting and disturbance of the beds, and the native papers say that there is little profit in their operation. In this, as in every other coal-field in China, there is a large amount of native mining upon a small scale. Farther to the southeast, near Yi-hsien (118° 30' E., 35° 0' N.), is a bituminous field which is said to be larger and better, but which I have not visited. The production of the native

mines is already important. A large native company, called the Chung Hsing Kung Ssu, has been formed, machinery procured from Germany, and a railroad constructed from the mines 35 miles to the Grand Canal. This will probably be extended to connect with the Tientsin-Pukou railroad,* and when the latter road is in operation the production of coal in this district should become important.

Much has been written concerning the coal-fields of Shansi, and having spent some time in visiting the more important localities, the temptation is strong to describe them fully. But since others, ^{12, 54, 44, 45}, have discussed them in more or less detail, I shall only refer to them briefly. These anthracite-seams are the most striking coal-beds in the country as they are so thick, so little disturbed, so well exposed, and so widely distributed, having an extent of nearly 200 miles north and south, and from 25 to 30 miles east and west. There are several seams, one of which is especially thick and persistent. Richthofen⁴⁴ estimated the area of the field as 13,500 sq. miles, and Drake¹² estimated the average workable thickness of the seams as 22 ft. As the beds are frequently but slightly inclined, this corresponds to a yield of over 22,000,000 tons per square mile of workable area, so it is safe to estimate that the anthracite-resources of this part of China are at least equal to those of the United States. Mining in this field is under the control of the Pao-Chin Mining Co., which was formed by the gentry of the province to repurchase the concession of the Peking Syndicate. Several shafts are making a small production, most of the present output coming from native workings. The area controlled by the Pao-Chin Mining Co. is of immense importance, and it is to be regretted that so little progress is being made. There were, in 1910, no trained engineers in the employ of the company, though there are numbers of properly qualified Chinese engineers available. The analyses given in Table V., most of which were made by C. H. Wang, exhibit the character of the coals. An interesting feature is the high content of phosphorus, and the importance which this has had in the native metallurgy of iron is discussed in the section devoted to that metal. Shansi also possesses considerable resources in bituminous and semi-anthracite coal, which is produced both to the east and west of Tai-yuan-fu and sold in considerable quantity in that city. Analyses are given in Table V.

* Now connected.—Ed.

TABLE V.—Analyses of Shansi Coals.

No.	Locality.	Moisture.	Volatiles.	Fixed Carbon.	Ash.	Sulphur.	Phosphorus.	Analyst.	Sp. Gr.	Remarks.
1	Chuang-chuang-kou.	Per 0.91	Per 8.20	Per 78.75	Per 12.14	Per 0.67	Per 0.476	C.H. Wang.	.....	Semi-anthracite, does not coke.
2	Hon-ho-kou	0.94	6.15	85.70	7.21	0.59	n. d.	C.H. Wang.	.....	Hard dry anthracite.
3	Han-ho-kou	0.88	8.55	84.00	6.72	0.409	0.23	F. N. Lu.	1.38	
4	Tuan-chia-kou	0.76	6.44	79.10	13.66	0.683	1.80	F. N. Lu.	1.35-1.38	
5	Lao-hsien-sheng-kou.	0.66	4.49	89.50	5.46	0.509	2.53	F. N. Lu.	1.4	
6	Nan-tien-meng	2.01	7.05	81.35	9.61	0.867	n. d.	F. N. Lu.	1.3-1.5	
7	Meng-tsen-cheng	0.33	4.39	89.25	6.03	0.405	2.15	F. N. Lu.	1.3 high	
8	Chuang-chuang-kou.	14.75	19.28	52.42	13.45	9.89	n. d.	C.H. Wang.	.....	Coked in crucible, probably due to oxidation.
9	Chung-tsi-kou	0.50	14.20	75.89	9.41	0.258	n. d.	F. N. Lu.	.....	Semi-bituminous, coked in crucible.
10	Tung-chia-chuang	1.73	10.72	84.22	3.33	1.150	n. d.	C.H. Wang.	.....	Semi-anthracite, does not coke.
11	.....	1.93	3.45	81.44	14.17	0.35	n. d.	.....	.....	Average of 6 analyses by Drake. ¹²
12	.....	2.91	(86.80)	.....	9.88	0.41	n. d.	.....	.....	Average of 6 analyses by Shockley. ⁴⁷

In Shensi, which adjoins Shansi on the west, extensive coal-fields are known to exist, and Richthofen, ^{44, 45}, thought that the bituminous-fields to the west of Tai-yuan-fu were of equal extent and importance as the anthracite-fields to the east. This is possibly too optimistic

Samples 1 to 8 were taken throughout the district (113° 30' E., 35° N.); sample 9 from (112° 40' E., 37° 55' N.); and sample 10 from (112° 40' E., 37° 50' N.).

but they are certainly very great. I have estimated the production of this province as 500,000 tons, but this is problematical, as the area is so little known. The same remarks apply to Kansu, which adjoins Shensi on the west. I have, for this reason, omitted Mongolia from Table I., though it is known to possess coal-seams in those portions which adjoin Chihli and Shansi. Passing directly south, to Ssu-chuan, Kwei-chou, and Yunnan, our knowledge is in a similarly unsatisfactory state. Richthofen,⁴⁵ who only traversed the northeastern part of Ssu-chuan, says, in substance, that coal is very generally worked throughout the province, as the Mesozoic strata are extensively folded and are cut across by the rivers, thus conveniently exposing the seams. So far as I can learn, the coal here is not of as good quality as other deposits more favourably situated with respect to the larger markets, which, together with the difficulties of transportation on the Yangtze, restricts production to the amount required for local needs. A few years ago, a British company secured a concession at Wan-hsien (108° 30' E., 31° 0' N.) and installed modern machinery, but it has now been handed over to a native company and is worked by native methods. Baber,¹ Hosie,¹⁸ Duclos,¹³ LeClere,²⁵ and others have noted many places where coal is worked in Ssu-chuan. Duclos has discussed at some length the occurrence and methods of working coal in Ssu-chuan; his remarks are best summarized by a quotation from his report: "Le charbon se trouve presque partout dans le province, donnant lieu à de petites exploitations qui subviennent aux besoins locaux." LeClere,²⁵ who has a favourable opinion of the coal-resources of southwestern China, says that coal occurs at four horizons, from lower Palæozoic to Rhétic, and is widely distributed over a quadrilateral area bounded by 'Lao-Kay' (101° 31' E., 22° 30' N.), 'Yunnan-hsien' (100° 30' E., 23° 0' N.), 'Tchao-toung' (101° 31' E., 27° 30' N.), and 'Kouei-Yang-hsien' (104° 20' E., 26° 20' N.). He thought that the field most favourable for exploration is that lying to the west of Mengtze (101° 0' E., 22° 45' N.). Duclos¹³ mentions four places in Kwei-chou where coal is produced: 'Mao-py', 'Tchen-lin' (103° 15' E., 26° 0' N.), 'Choui-tang-pou', and Ma-lou-kio (102° 27' E., 26° 58' N.).

The anthracite-field of Shansi extends southward into Honan province and at Ching-hua-hsien, 113° 40' E., 35° 15' N. approximately, the Peking Syndicate has several shafts equipped with modern machinery, in operation. This company has had a good many vicissitudes, but is now meeting with success; the production during 1910 is given as 357,205 tons. There is a good deal of production by native methods in this province.

The great southern coal-field lies to the east of the Hsiang river, in Hunan and Kiangsi provinces. The greater part of the field is in the former province, but the most important producer, the collieries of the Han-Yeh-P'ing Iron & Coal Co., are at P'ing-hsiang (113° 50' E., 27° 30' N.), in Kiangsi. This coal is a bituminous coking variety (with associated thin seams of anthracite), which contains 28 per cent. of ash as mined, but after washing and drying an average analysis furnished by the company gave:

	Per Cent.
Volatile hydrocarbons,	22.35
Fixed carbon,	68.00
Ash,	8.70
Sulphur,	0.10

It yields excellent coke, which supplies the blast-furnaces at Han-Yang and the general market; more than 107,000 tons having been produced in 1909. Further details can be found by consulting³⁷ and⁴⁶. The production for 1910 is given as 610,000 tons. The coal-fields extend west and south from this point for a great distance, and Richthofen⁴⁵ says that southward the coal is anthracite and of better quality. Transportation is difficult, owing to the shallowness of the rivers; so development has lagged; but when the Canton-Hankow railway, now under construction, is in operation, this field, which I regard as only second in

importance to the Shansi field, is likely to develop greatly. Some of the most important mineral regions in China lie to the west of the projected railway-line, and the transportation-facilities thus afforded should lead to a great increase in mineral production.

The coal-fields of Chekiang are of little importance. In Kwangtung and Kwangsi coal is mined at a number of places, but I have no personal knowledge of this area. My impression that these coal-deposits are worked because of their proximity to important centers of trade, rather than because of their superior quality, is not improbably correct.

Despite the importance of the coal-fields of China, it is impossible to afford more space to their discussion. Reference should be made to the papers quoted for further details. In conclusion, it should be said that the coal-fields of China are of great extent, the coal is generally of good quality and the fields are widely scattered, so that no parts of the country are far distant from the sources of supply. In extent and quality the coal-resources of the country compare favourably with those of the United States. As a rough comparison, it may be said that Chinese coals are slightly younger than those of North America, most of the fields being upper Carboniferous or Permian. In the north, Jurassic and Tertiary coals occur, but except for the Fushun field, are of little importance as yet. There has been a good deal of controversy over the exact age of these coals, but it is of little interest to mining engineers. Bituminous coking-coal is very common; coke made by native methods can be obtained almost anywhere in the country. When made from washed coal, the resulting coke is of excellent quality, and will afford an abundant supply for the smelting-industries which are likely to develop. The anthracite is of excellent quality, but the bituminous is often friable, yielding an excessive proportion of fine coal. When worked on a large scale this can be washed and converted into coke. The Chinese custom is to make the dust into briquettes with clay as a binder, which are dried and burned. In recent years the number of mines equipped with modern machinery has become comparatively great, and the present supply amply meets the demand. The mines of the Fushun Co. and the Chinese Engineering & Mining Co. now chiefly supply the railway and shipping-trade of North China, because of the superior transportation-facilities which they enjoy. These two companies also send coal to the cities along the SE. coast, competing with Japanese coal. Coal-production throughout China exhibits a healthy and vigorous growth. The annual production of the country as shown in Table I. is estimated at 15,000,000 tons; but this amount is only approximate. The amounts given for Yunnan and Ssu-chuan, for example, should be designated as guesses rather than estimates, and the figures occasionally seen in statistical tables giving the production of the country to the nearest thousand tons are totally misleading in the false appearance of accuracy which they present.

III. IRON.

Iron is the second in importance of all the mineral resources of China, and the security of the future of China as a mineral-producing nation is easily appreciated, since it is founded upon an abundant supply of coal and iron, the two bases of industrial development. In the case of other minerals it may be inferred, without falling into serious error, that practically every occurrence of importance has been worked, to a slight extent at least, by native methods. But this is not true of iron-ore deposits. The great importance of the lack of transportation-facilities upon the development of mineral wealth has already been mentioned, and it is in the case of iron that its influence has been most marked. In the native method of iron-smelting such large quantities of coal are used that it is necessary to have both coal and iron-ore in close proximity in order to permit the development of a smelting industry. This condition obtains in several provinces, but most notably in Shansi, where it has been described by Richthofen,⁴⁴ and Shockley.⁴⁷

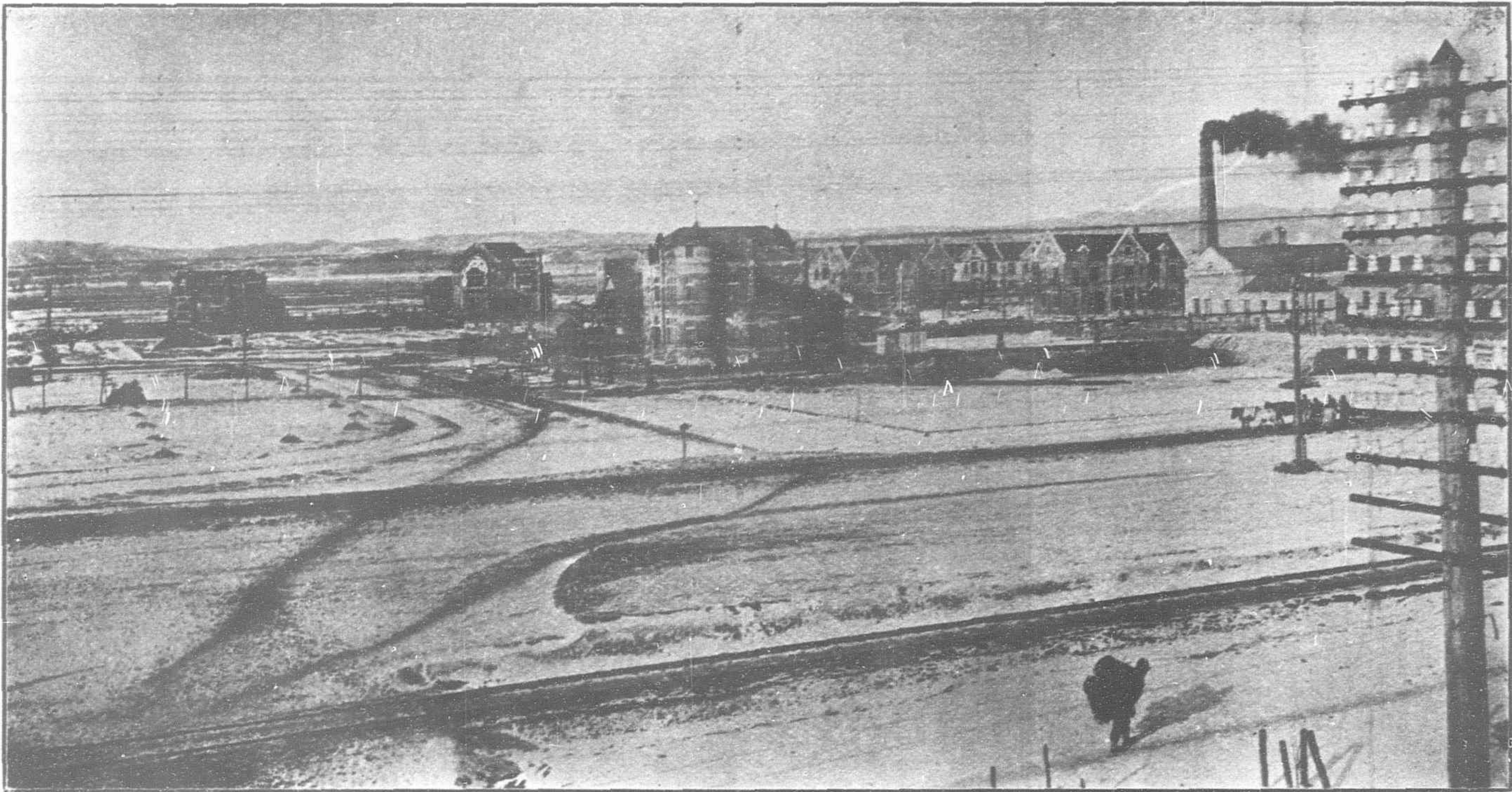
But while these deposits are adapted to the native methods of working, they are not at all suited to modern methods, where a large supply of uniform quality and high iron-content is necessary. It is reasonably certain that such deposits exist in numerous places; but, except in the case of the Ta-yeh mine, to be described later, they have not yet been developed because the necessary supply of coal does not exist near-by. A sketch-map showing the iron-centers in China is given. A description of the deposit at Ta-yeh will be given, followed by a list of the principal localities throughout the country where iron-ore is known to occur. I will preface this by a description of the P'ing-t'ing-chou district in Shansi, the principal one in which iron is produced by native methods. The accounts of this by Richthofen have already been mentioned; what is here given, however, is based upon notes made during the winter of 1910. The analyses given of the raw materials and products have been made by my former students, C. F. and C. H. Wang and F. N. Lu.

The iron-ores of Shansi are limonite and hematite, occurring in shales and sandstones of Carboniferous age; the varieties of method of occurrence are so numerous that to attempt their description would require too much space. Usually they are in masses of no great size, commonly in or near a disturbed zone in the strata, or else in beds or flat veins, from a few inches to not more than 3 ft. thick, of limited extent. It follows, therefore, that no sufficient supply of uniform ore in enough quality can be obtained from the Shansi deposits, so far as yet explored, to form the basis of blast-furnace work on a large scale. More recently it has been reported that on the southern border of this district, in Honan province, a suitable deposit has been found, and it has been proposed to erect there another government iron-works, similar to the one described later. Two analyses of the ore from T'ai-yang, near Tze-chou-fu, as given by Shockley,⁴⁷ are shown in Table VI.

TABLE VI.—Analyses of Iron-Ore
from T'ai-Yang.

	I.	II.
Fe	53.88	45.50
SiO ₂	4.67	11.15
Al ₂ O ₃	3.46	6.42
MnO ₂	0.57	0.51
CaO	2.21	5.50
MgO	trace	0.25
P ₂ O ₅	0.57	1.08
S	0.074	0.016
CO ₂	9.37	2.70
H ₂ O	2.20	7.35
Analysts,	Edward Riley, Pattinson and Stead.	

The ore, mined through shallow round or rectangular shafts, is broken into small pieces and hand-sorted into several grades, which are sold to the smelting-plants. Here it is mixed with 50 per cent. of its volume of coal and packed into cylindrical crucibles, 5 in. in inner diameter, and usually 45 in. high, Fig. 10. From 250 to 275 of these crucibles are set upright in a rectangular furnace, about 12 by 6 by 4 ft. Air-space is secured at the bottom by a layer of broken crucibles, over which is placed a layer of coal; then the crucibles are set in place, with coal between them; the front side is closed, the whole is covered over with coal and allowed to burn by natural draft for three days. The crucibles are then removed and the contents taken out. This operation usually involves breaking the bottom part of the crucible, which now contains an irregular "bloom" of iron of very variable composition (Table VII.), irregular fragments of iron, earthy residues, and a certain amount of coke. The bloom is sold to the makers of wrought-iron, the small pieces of iron are sold to the makers of cast-iron, and the coke is used in the manufacture of crucibles. It should be noted that the product of this method of melting is not pig-iron, in the ordinary sense of the word, as it contains very little carbon, and is malleable. The bloom is worked into wrought-iron by heating in a wood fire and hammering until it



THE FUSHUN COLLIERY OF THE SOUTH MANCHURIA RAILWAY

is worked down into a rectangular ingot, which is then sold, and either manufactured locally into various objects and utensils, or shipped in the ingot form to all parts of the country. The small pieces of iron are mixed with coal and placed in crucibles, about 7 by 14 in., and from 50 to 80 of these are placed in a smaller furnace, blown by hand. When the iron is melted the covering of the furnace is removed, the crucibles are taken out, the contents of several crucibles are poured into one, and this is then poured into molds, which have previously been prepared with extraordinary skill. In this way various cooking-utensils, especially *kuo*, are cast, often of remarkable thinness, as the castings contain as much as from 5 to 7 per cent. of phosphorus, which has been taken up from the coal during the reduction and remelting.

Note in Table VII., sample No. 12, the high percentage of phosphorus in the cast-iron bar.

It is not at all improbable that the high phosphorus-content of the Shansi coals, Table V., samples Nos. 5 and 7, has been the chief factor in the great development of the industry, as it has afforded an easy means of securing the high-phosphorus iron necessary in making thin castings. Formerly the iron-products of this locality found their way through the channels of trade to nearly all parts of the Empire. Now the trade in native iron exists chiefly in the interior, as foreign scrap-iron and steel, especially old horse-shoes, are imported in large quantities into all the treaty-ports; and because of their superior quality and low price tend to drive out the native product. The native industry, therefore, is steadily dwindling, though it will continue to exist until foreign cooking-utensils displace the high-phosphorus cast-iron *kuo*. Shockley ⁴⁷ has called attention to the amount of decrease between the time of Richthofen's

visit and his own. Table VIII. gives the production, as estimated by Shockley, of the chief districts of Shansi in 1901.

TABLE VIII.—*Annual Production of Native Iron in the Chief Districts of Shansi.*

	Tons
Yu-hsien,	4,500
P'ing-ting-chou	18,000
Yiu-ch'eng,	6,000
Kao-p'ing-hsien,	4,000
Tse-chou-fou,	13,333
Yang-ch'eng,	2,000
Ch'in-shui,	1,415
Tai-yuan-fu.	2,000
Total	51,248

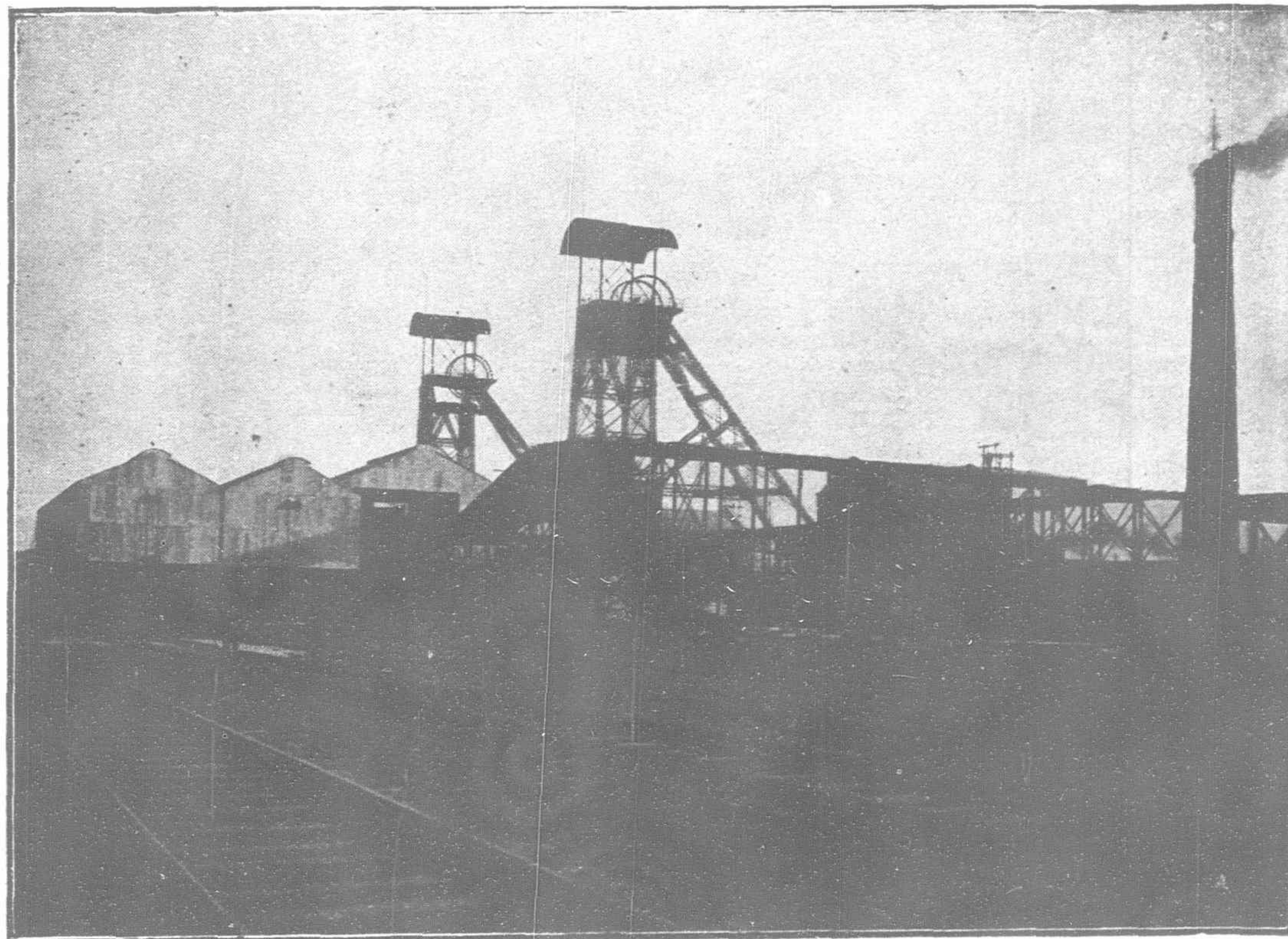


VIEW OF FUSHUN

TABLE VII.—Average Phosphorus and Sulphur-Content of Native Pig-Iron
P'ing-t'ing-shan, Shansi, China.

Sample No.	Locality	Phosphorus	Sulphur	Remarks on Samples
1	Li-chia-chuang	Per Cent. 1.7314	Per Cent. 0.5489	Clean, malleable
2	T'ao-p'o	0.4671	0.1781	Dirty, malleable
3	Yang-chia-chuang	4.8400	0.4577	Rather clean, brittle
4	Nan-yao-kou	2.6066	0.2486	Dirty, globular
5	Chien-mu-p'ing	0.8527	0.1254	Dirty, porous, brittle
6	San-ch'uan	0.6854	0.1365	Clean, porous, brittle
7	Yang-shu-kou	1.3075	0.6140	Dirty, porous, slightly malleable
8	San-tu	0.4645	0.4945	Dirty, porous, slightly malleable
9	Ing-Ying	3.5700	0.6375	Clean, hard
10	Hao-ho-kou	3.7645	0.2999	Clean, hard
11	Wu-tu	0.7315	0.2155	Clean, malleable
12	Yang-chü-Hsien	6.9340	0.2196	From a cast-iron bar
	Average	2.3479	0.3480	

Analyses by Cheng-Fu-Wang.



TOGO PIT FUSHUN COLLIERY, SOUTH MANCHURIA

The following notes of the only modern steel-works existing in China at present were made during a visit to its iron-mines and metallurgical plant during the summer of 1908.

The blast-furnace and steel-plant of the Han-Yeh-Ping Iron & Coal Co. is situated at Hanyang, just across the Han river from Hankow, in Central China. Its iron-ores are mined at Ta-Yeh, about 50 miles S.W., and its coke is obtained from its colliery of P'ing-hsiang, in Kiang-si province, more than 300 miles distant. The relative positions of the properties are shown on the sketch-map Page 57.

The iron-ores at Ta-Yeh occur about 15 miles west of the Yangtze river, and lie along the contact between a marble and an intrusive body of a dark gray syenitic rock. There is no direct evidence in the neighbourhood as to the age of the marble, but on lithological grounds it seems identical with the limestone occurring near Nanking, which Richthofen ⁴⁵ has called the 'Sihia.' (He has translated the Chinese characters incorrectly; it is properly 'Hsi-hsieh.') Richthofen has suggested the age as Devonian, but the closely-associated coal in both localities makes it much more probable that it is rather to be regarded as Carboniferous, since the Devonian is generally very poorly developed in China. There is much doubt as to exact correlation of China fossil fauna with that of other countries, and in nearly all cases coals in China belong to the Carboniferous, or the immediately overlying series. If these two are identical, it would then appear that this limestone is a horizon for iron-ores in the Yangtze valley, as they are associated with it in notable amount near Nanking, as will be noticed later.

The ore is a good quality of hematite of about the following range of composition, furnished by the Han-Yeh-Ping Iron & Coal Co.:

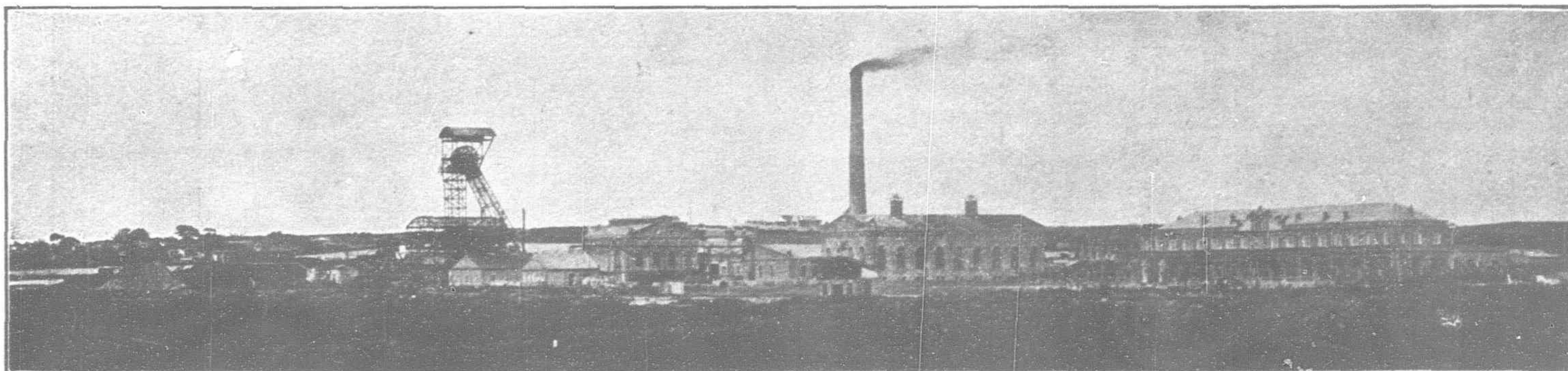
Iron Ore, Ta-Yeh.

	Per Cent.
Fe	60 to 62
P	0.05 to 0.25
S	0.05 to 0.12
SiO ₂	3 to 5
Al ₂ O ₃	1 to 2
Mn	0.2 to 0.4
Cu	0.05 to 0.25

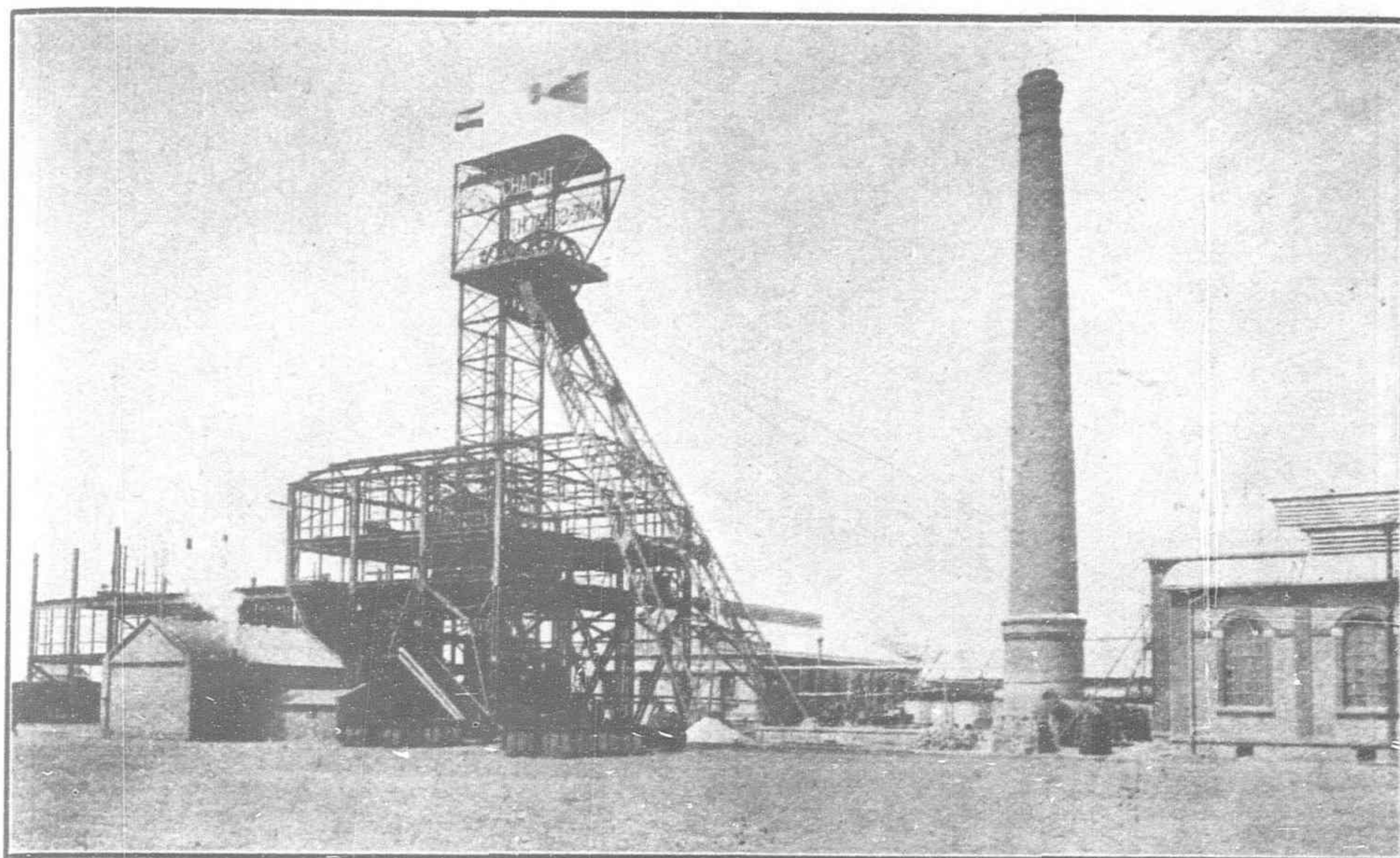
At one place it is slightly magnetic, apparently having been partly reduced to the magnetic oxide by the action of reducing solutions, which have deposited small amounts of copper and iron sulphides along the foot-wall. During the Ming dynasty, efforts were made to work this deposit as a copper-mine, but could scarcely have been very successful. The iron-ore is opened up over a length of more than 2 miles, but apparently is not continuous over that extent. The contact runs nearly east and west, and for considerable distances to each side of the present workings the ores can be traced. Where it is worked the ore-body is about 200 ft. thick and is nearly vertical, dipping slightly to the north. The syenite lies to the north of the marble, and a few miles farther north the marble again appears, iron-ore again being present along the contact. It would be entirely

impossible to estimate the amount of ore available in this district, as in the workings only open-cuts are made, and the ore is nowhere blocked out in such a way that it can be accurately measured; however, the officers of the mining company believe that they have many millions of tons of good ore on their property, and there seems no reason to doubt this.

At the metallurgical works at Hanyang, two blast-furnaces, each of 100 tons daily capacity, are in operation, and a third unit of 250 tons capacity has just been completed. Three Siemens-Martin open-hearth furnaces are in operation, two are under construction, and five more are projected. The rolling-mill has a capacity of 800 tons per day: the larger part of it is devoted to rolling railway-material, as the greatest demand in China is for material of this nature. During 1909 there was produced 307,500 tons of iron-ore, of which a large part was exported to Japan and America, and the remainder smelted at Hanyang. Of the resulting pig-iron, 44,300 tons was sold as such, and the remainder converted into 28,500 tons of steel, chiefly steel rails; 3,600 tons of manganese-ore of good quality was produced in 1908 at P'ing-hsiang, in the province of Kiangsi. In several other places the company owns deposits of manganiferous limonite which contains about 20 per cent. of manganese, which can also be utilized if necessary. The



THE LANCHOW COAL MINES, CHIHLI



SHANTUNG MINING COMPANY: SHAFT AT FANGTZE

company has a contract with the Japanese government iron-works at Wakamatsu to supply them with ore of Bessemer grade, and has recently made a contract with the Western Steel Corporation to furnish it yearly with 36,000 tons of ore and 36,000 tons of basic pig-iron.

The occurrence of iron-ore throughout the Empire is given in the following list of the places where deposits of iron-ore are known to exist, beginning at the north.

In Manchuria quite an amount of iron is produced¹⁹ by native methods at T'ieh-ling, 44 miles north of Mukden, the ore coming from an adjacent range of hills. Recent Japanese reports are to the effect that iron-ores containing about 50 per cent. of iron exist along the line of the Mukden-Antung railroad, and also at Sai-ma-chi, Tung-hua, and 'Puijin.' The NE. part of the province is only sparsely settled, and no other deposits have yet been opened.

Practically nothing is known of the iron-resources of the vast extent of Mongolia. At present the lack of transportation removes them from consideration, but it is not unlikely that the Peking-Kalgan railroad will be extended to meet the Trans-Siberian road, and the coal and iron-resources of this great area may have to be considered in the future.

The iron-ores of Shansi have already been described. Richthofen states that in Shensi the conditions as regards iron-ores are probably similar to those in Shansi, and assigns their lack of development to the character of the coal, which is not so suitable for the native methods of smelting. The fact that Shansi lies much nearer the markets for iron is also of importance, for where transportation is so expensive it would be impossible to ship across a producing district and compete with it, unless conditions were immensely more favourable in the more remote district. At any rate, Shensi must also be included as an area of which but little information is available at present, but which may become of importance in the future.

In the province of Chihli iron-ore occurs at several places, notably in the NE. part; but I do not regard any of these as likely to become the basis of a permanent industry.

Magnetite occurs in the province of Shantung, at P'ao-shan, about 50 li south of Tung-chou. Not far from this locality, at 'King-kwo-shan,' different ore occurs, according to Williamson.⁵² Near Chefoo specular ore occurs. It is not probable that the ores at these and numerous other places in the province offer much promise of success by development on a large scale, otherwise the German interests which have been so active in stimulating the growth of industry in the province would have undertaken their exploitation.

In Kiang-su province iron-ores are widely distributed, occurring chiefly in the region

about Nanking in association with the limestone previously mentioned. Richthofen⁴⁵ seems to regard these of little promise because of the absence of coal of suitable quality in the neighbourhood. But when the distance to which iron-ores are transported in the United States is considered, and the fact that the ores in question are conveniently adjacent to the Yangtze river, it seems much more probable that these ores will be the next to be developed on a modern scale. The ore is probably of similar character to that of Ta-yeh, previously described.

In the province of An-hwei the geological conditions are similar to those in Kiang-su and Hu-peh. A concession was granted to the London & China Syndicate to exploit copper-mines in this province. A few years since, when the Chinese government was about to cancel the concession, the company claimed to have developed ore of a value of more than \$4,000,000. But I have been unable to secure any accurate information regarding this concession.

The iron-ores of Hu-peh province have already been described. A recent report made by some students sent out by that provincial government is to the effect that workable deposits exist at six localities.

The province of Ho-nan is largely alluvial plain. In the NW. part the conditions are similar to those existing in Shansi, and similar ores occur. These ores have not been the basis of a flourishing native industry, but some large deposits are known to occur, and it has recently been proposed to develop them by modern methods.

In Ssu-ch'uan iron-ore is widely distributed, and both Baber¹ and Hosie¹⁸ mention numerous places in which it is the basis of a native industry; but neither of these authors gives enough details upon which to base a judgment as to the future of the industry.

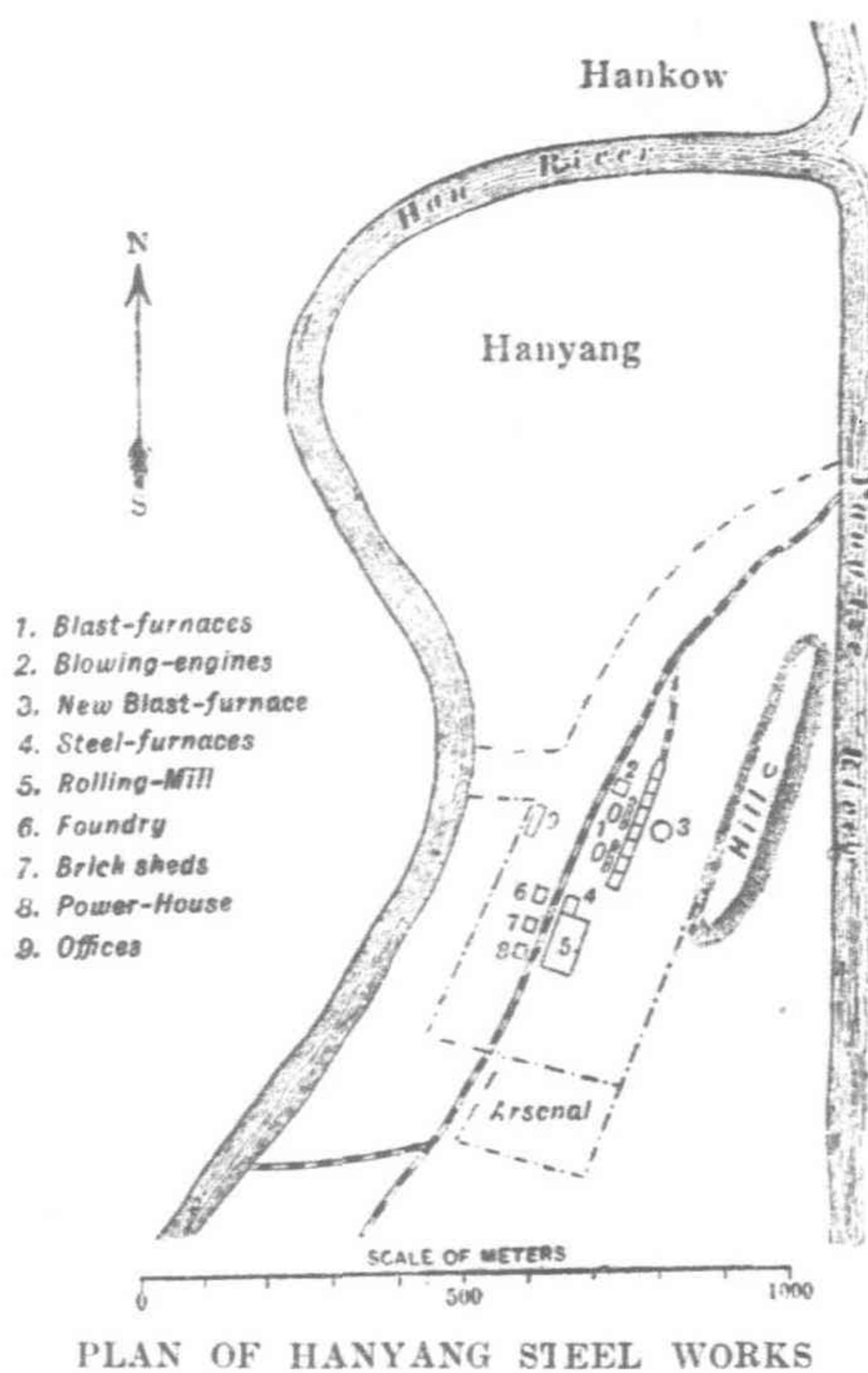
In regard to Yun-nan and Kuei-chow information is even more meager. Numerous travellers and explorers agree that iron-ores are widely distributed throughout Yun-nan, but there is an entire absence of definite information. A similar statement may be made in regard to Kuei-chow. The native industry in these provinces must be in a flourishing state, judging by the exports of native material.

On the maps prepared by La Mission Lyonnaise the following places are marked as productive of iron: Ssu-chuan (105° 50' E., 32° 10' N.), (105° 40' E., 20° 45' N.), (104° 40' E., 29° 15' N.), (104° 50' E., 29° 05' N.), (104° 30' E., 28° 48' N.), (102° 05' E., 29° 40' N.). Kuei-chow (103° 0' E., 26° 10' N.), (102° 50' E., 26° 50' N.), (103° 30' E., 27° 15' N.), (104° 0' E., 25° 20' N.), (104° 50' E., 29° 0' N.), (104° 50' E., 29° 20' N.), (106° 05' E., 27° 0' N.). Yunnan (99° 45' E., 24° 20' N.). Kwangtung (109° 20' E., 24° 40' N.), (111° 05' E., 24° 25' N.), (111° 05' E., 23° 50' N.), (112° 0' E., 23° 45' N.), (113° 30' E., 23° 0' N.). LeClere²⁵ says that iron-deposits are common in Yunnan, and are worked in places where the supply of charcoal is abundant. He also refers to the iron industry in the northeastern part of Kweichow. Duclos¹³ reports what is almost incredible, that the Chinese smelt iron-ores in blast-furnaces in Ssu-chuan.

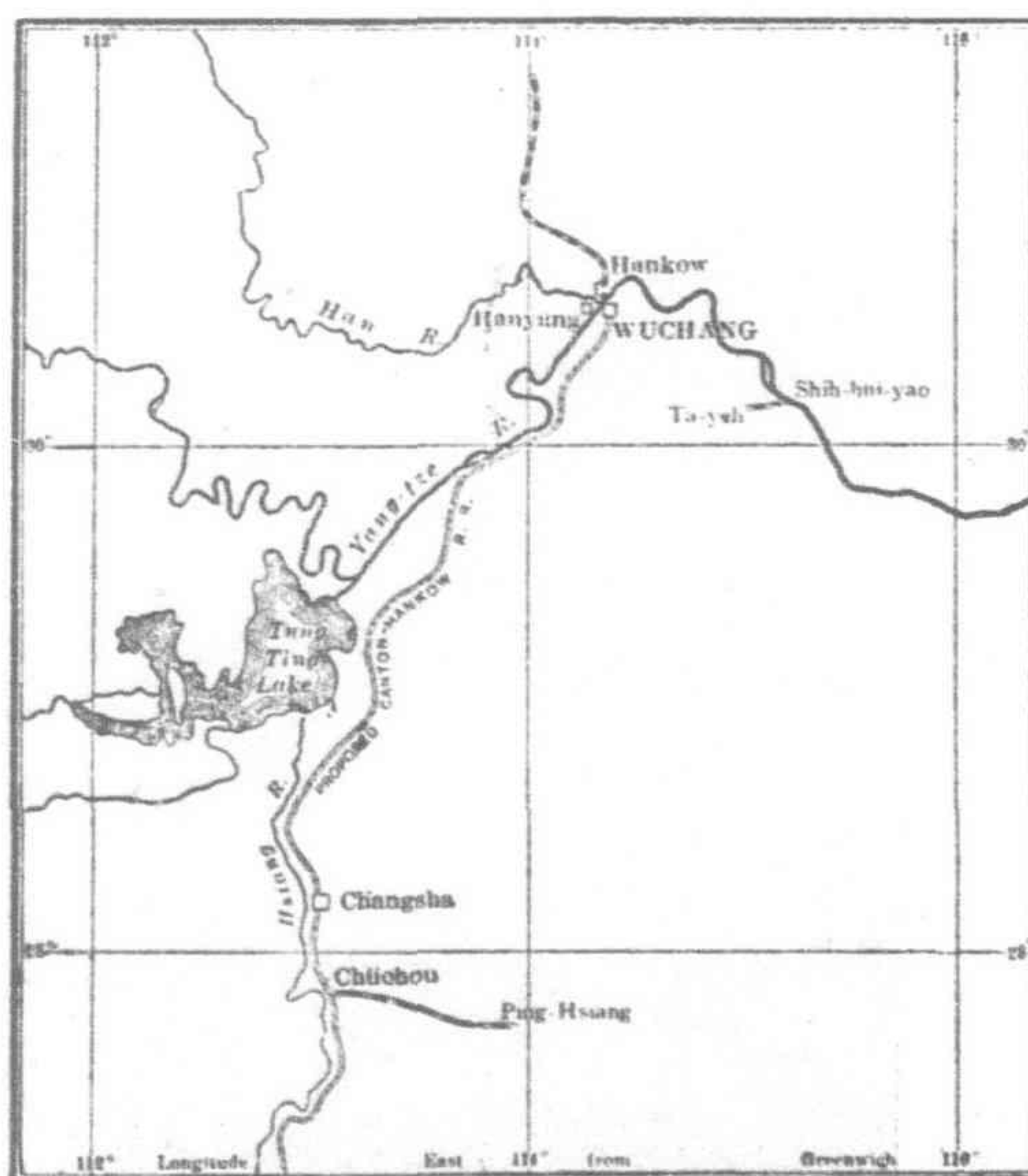
Iron-ore of inferior quality occurs in Hunan, but is only worked by the natives at Chin-chou, near the southern border of the province, where the quality is much better. Very probably exploratory surveys would disclose valuable deposits at points not convenient for the application of native methods.

The manganese-ores at P'ing-hsiang, in the province of Kiang-si, have already been mentioned. Manganiferous limonites also occur along the Yang-tze, in the NW. part of the province, and it is not improbable that ores occur in other parts of the province, but are not worked by the natives.

In Che-kiang province there is a native industry in an area extending from near Ning-po down into the province of Fu-kien. But as the ores consist of grains of hematite which are washed by hand from the sands of the streams, this district may be dismissed as of no future importance.



PLAN OF HANYANG STEEL WORKS



MAP SHOWING RELATIVE POSITIONS OF THE HANYANG PROPERTIES

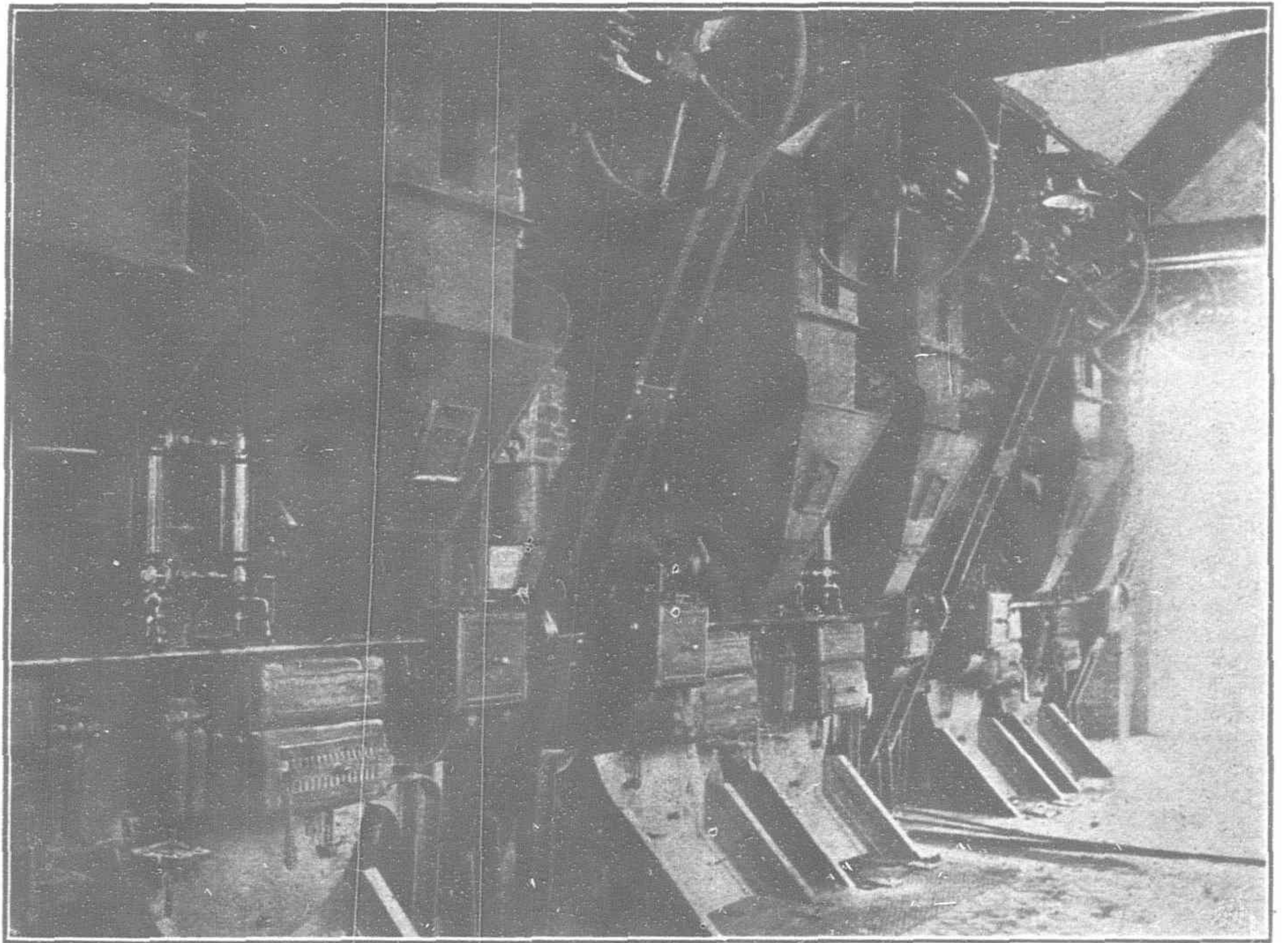
At 'An-Khoe,' in Fu-kien province, about 60 or 70 miles from Amoy, there is a large deposit of magnetite, estimated to contain 10,000,000 tons of ore, according to a report given to me by consular officials. It is favourably situated for working, but unfortunately the report says nothing as to the amount of titanium present in the ore.

In Kuang-tung and Kuang-si provinces, iron-ore is produced in Hsin-hui-hsien, and is both produced and smelted at Hsin-hui-hsien and Yang-an-hsien; the annual production at the latter place amounting in value to \$250,000 gold.

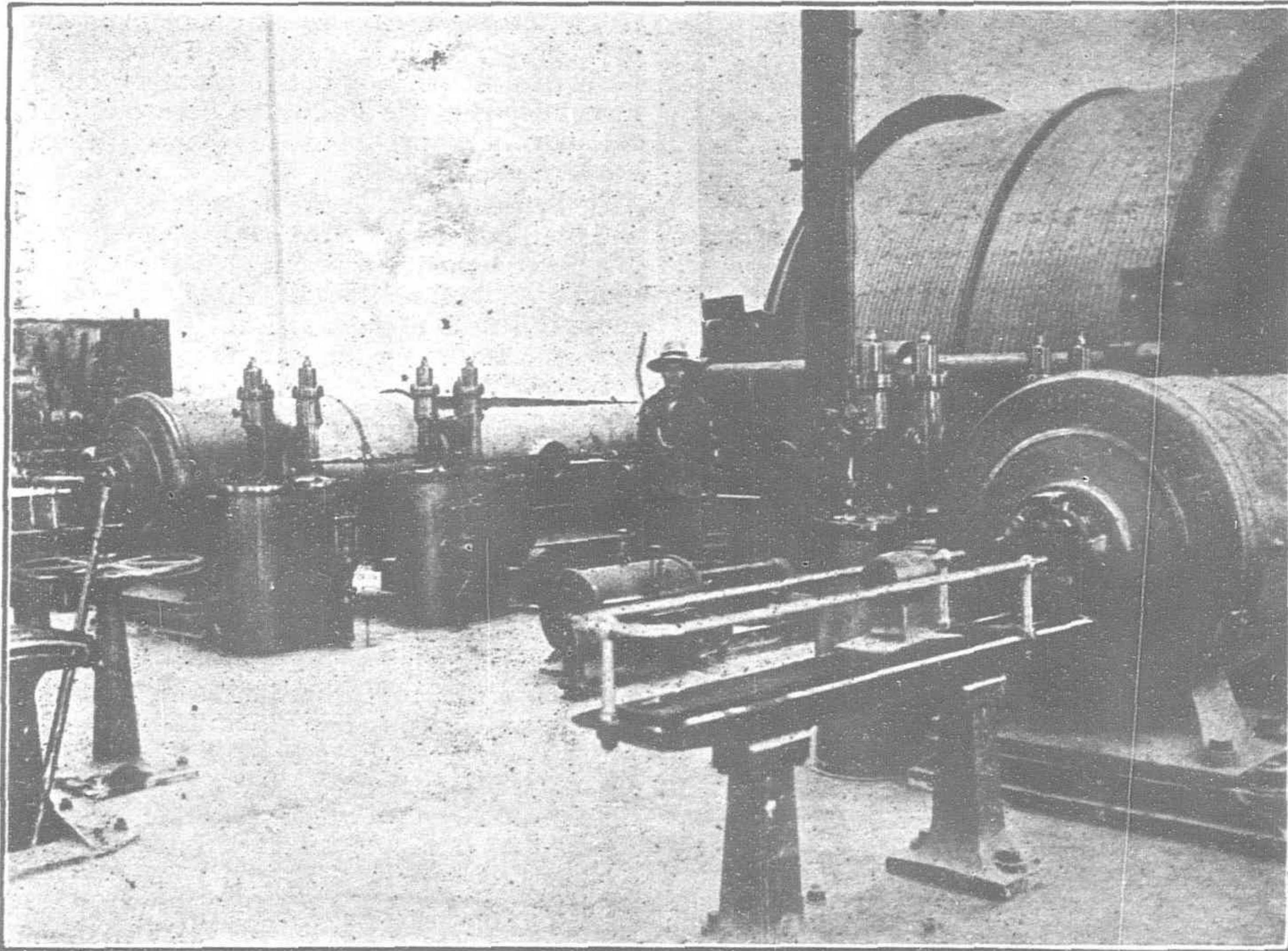
The cost per ton of production of iron-ore in the open-cut workings at Tayeh is approximately as follows:

	Mexican Currency.
Stripping,	\$0.08
Mining,	0.18
Tramming,	0.03
Powder, steel, etc.,	0.015
Superintendence,	0.06
Loading cars, freight to Yang-tze, etc.,	0.30
Total,	\$0.665

From these data the probable cost of the ore delivered at the blast-furnace would amount to a little more than \$1, Mex., per ton. The cost of limestone is about two-thirds of this; the cost of coke \$15, Mex., and coal about \$8, Mex. These low costs are largely due to the low cost of labour. Ordinary unskilled labour receives



MECHANICAL STOKER INSTALLED IN THE BOILER HOUSE AT THE MACHIAKOU MINE



STEAM WINDING ENGINE INSTALLED AT THE MACHIAKOU MINE

from 200 to 300 *cash* per day, or from \$0.08 to \$0.12 gold. Skilled labour receives from \$5 to \$25 gold per month, and the efficiency of this labour is remarkably high. As a result, pig-iron and steel can be produced at a very low cost; pig-iron from this plant is not only sold in Japan, but also in New York and San Francisco. But as there is a growing market for the present output in China, it is scarcely likely to become a serious competitor in other markets, at least for the present.

In conclusion, it may be said that, while our knowledge of the iron-resources of the Chinese country is still inadequate, yet the general features appear to be these: Iron-ores are widely distributed throughout the country from north to south. In many places these have been the source of a more or less considerable native industry, which is steadily waning, because of the unsatisfactory quality of the product. Owing to the peculiar features of the native methods it is not to be supposed that modern industries will necessarily develop in the same localities; on the contrary, the one modern plant is



HAND OPERATED WINDING GEAR UTILIZED AT THE CHENCHIALING MINE

utilizing ores not previously worked by the natives, and this will not improbably be the policy of its successors. In this development of the iron and steel industry it is most probable that the Yangtze valley will have a leading place, as there seems good reason to believe that iron-ores of satisfactory quality, and in sufficient quantity, occur along a considerable portion of its length, and it also possesses the great commercial advantage of easy and cheap transportation, and a situation in the commercial center of the country. The extremely low cost of labour permits a low cost of production, making tariff for the protection of the industry entirely unnecessary. The low price of silver in recent years has operated to benefit China in a twofold manner: both by stimulating export trade and by discouraging imports. The resultant increase of wealth will give increased ability to meet the initial large expenditures necessary to develop modern plants. A large and increasing market is assured by the Imperial regulation that all materials required in the construction of railroads and other public works shall be purchased from the Chinese plants, so far as these are able to furnish them. As a result, it is to be expected that the iron and steel industry of China will have a large and healthy growth.

IV. GOLD.

Gold in China has unusual interest at this time, since the proposal to place the coinage of the country upon a gold basis is now receiving more serious consideration. The fact that the gold-production is so small has always acted as a strong deterrent to the establishing of a gold coinage. Since China produces but little of either gold or silver, and must purchase them with exports of merchandise, the advantage of buying silver at its present low price is apparent. At present silver and copper are the media of exchange; the former passing at an approximation to its bullion value, while the copper *fung-tz'erh* and *cash* are subject to daily fluctuations of value. As each province now issues coins, which pass only at a discount, or perhaps not at all, in other provinces, the transaction of business is subjected to a wholly unnecessary burden. The central government, having acquired control of the railways, will doubtless next proceed to complete its present shadowy control of banking, and a gold standard may be introduced, as large amounts of foreign capital are now invested in China, and interest payments are at present subject to sudden and extensive changes in the rate of exchange.

The absence of records of mineral production renders it difficult to obtain any knowledge of the gold-production of the country. The best approximation can be made from the customs-records of gold exported, since the amount used annually in the arts is but small. The export for 1908 was approximately \$6,500,000; that for 1907 was \$3,200,000. The occurrence of gold in China has been noted by Baber,¹ Garnier,¹⁵ Duclos,¹³ LeClere,²⁵ Jack,²¹ Verschoyle,⁴⁹ Hoover,¹⁶ Hosie,^{18, 19} and others,^{9, 14, 20, 26, 27, 28, 29, 33, 34, 35, 36, 39, 43, 44, 50, 51, 52, 54, 57}; but the most notable descriptions are by Hoover,¹⁶ Hosie,¹⁹ and Purlington.³⁹ The last has described at length the occurrences of alluvial gold in northern Manchuria, along the Amur, Sungari, Tumen, Urga, and Nonni rivers and their tributaries, and its recovery by primitive washing-methods. Gold also occurs in southern Manchuria, both in alluvial deposits and in narrow veins, frequently of the gash type. The Bureau of Mines of Manchuria has compiled a list of 10 localities where gold is worked in Fengtien province, and 40 others where it is known to occur.

Bogdanovitch² has published an excellent study of the deposits of the Liao-tung peninsula, dividing them into four classes: (1) existing stream-beds; (2) Pleistocene high-level gravels; (3) ancient valley alluvials; (4) marine placers. The northern area is of much greater importance. It will perhaps be safe to estimate that Manchuria produces from 75 to 80 per cent. of an annual output of from \$5,000,000 to \$7,000,000 for the whole country.

The gold-deposits of Chihli have been described by Hoover.¹⁶ These are widely scattered, the most notable being veins at Chin-Chang-K'ou (119° 56' E., 42° 26' N.), and at Chuan-Shan-tze (119° 12' E., 42° 26' N.). In 1910 the former was producing at the rate of \$150,000 per year, and the latter \$15,000 annually. There are numerous placers throughout the province, and Hoover¹⁶ estimated the total production for 1908 as \$1,000,000. In Shantung similar conditions prevail, except that the deposits are not so abundant.

The best-known mine in China is that of Chou-Yuen, about 40 miles SW. of Chefoo, where a quartz vein from 40 to 90 ft. wide has been uncovered for more than a mile in length. Curle⁹ reports that 200,000 tons of ore, worth \$10 per ton, has been developed. The ore is about 40 per cent. free milling, and many years ago a chlorination-plant was in operation upon the tailings from the stamps. The mine has been closed for many years by government order; but there has been constant effort on the part of foreign companies to secure the concession, and recently the Governor of Shantung petitioned the Peking government to allow the Chinese owners to operate the mine, fearing lest it might otherwise be lost. The near-by mines at Ping-tu are probably of considerable value. In spite of the government prohibition of mining a certain amount of work is carried on quietly, and Hoover¹⁶ estimated the gold

production of Shantung at \$12,000 annually. With the few exceptions noted there seems little probability that deposits of sufficient size can be developed to justify the construction of modern milling-plants, the cost of labour being so low that primitive methods give cheaper working-costs. The tailings from the chlorination plant, mentioned above, were bought by the neighbouring farmers, who carried the material home, and, in the dull agricultural season, ground it in native mills and panned it. The deposits near Wei-hai-wei have been described by Verschoyle,⁴⁹ but are of little importance. In northern Manchuria, which has not been adequately prospected, large-scale workings may perhaps be developed; but throughout the rest of the country progress is likely to take the form of increase and improvement of native mines, efficient and inexpensive pumps being the most-needed equipment of native mines. Hansen has recently reported that between Lanchow, on the western border of Kansu, and the border of Thibet, numerous placer-workings exist, carrying as much as 2 g. of gold per cubic yard. A modern gold-milling plant is in course of erection at this place. Quartz veins also occur, containing from 1.5 to 2 oz. of gold per ton; but as these statements are apparently based upon the reports of natives, they must be received with caution. A recent Russian report is to the effect that on the areas of the Tushetvohanovsky and Tzentzenhanovsky concerns, Mongolia, between January 14 and September 2, 1911, the gold-production was 84.25 poods (1 pood of placer gold equals \$9,000 approximately), as compared with 88 poods in the corresponding period of 1910.

Throughout the rest of the country quantities of gold are produced in many places, most of which are known to be of little importance. Ssu-chuan and Yunnan have been of much interest, since they are but little known. The upper waters of the Yang-tze are known as the Chin-sha, or 'golden sand,' but this does not necessarily indicate, as has been assumed, that especially rich alluvials exist along its course. Many travellers have mentioned the known or rumoured existence of gold-deposits in these two provinces, LeClere, Duclos, Baber, Hosie, Garnier, Jack, and Johnston, to name but a few, but definite information is only meager. At Mo-I-o, in Ssu-chuan (102° 05' E., 28° 15' N.), important quartz-deposits have been worked since 1880 by a combination of foreign and native methods. Small quantities of alluvial gold are reported from a great number of places, but in nearly every case the name of the district is given in such a way that identification is difficult or impossible. In giving the native names of little-known places, either the Chinese characters should be employed, or else the latitude and longitude should be given. In Yunnan the most notable mines are at Ta-lan-tung (101° 45' E., 23° 30' N.) at an elevation of 7,300 ft. (LeClere²⁵). These quartz veins in Palæozoic rocks are worked by native methods, yielding some \$60,000 per year. At Kin-Kiang, 60 miles from Ta-li-fu, rich conglomerate beds are worked by the natives. On the maps prepared by La Mission Lyonnaise the following places are marked as productive of gold: Ssu-chuan (90° 30' E., 30° 55' N.), (99° 45' E., 30° 40' N.), (99° 55' E., 30° 20' N.), (101° 50' E., 32° 40' N.), (101° 40' E., 32° 0' N.), (102° 15' E., 31° 40' N.), (102° 0' E., 29° 0' N.). Yunnan (98° 45' E., 23° 45' N.), (99° 50' E., 23° 20' N.). Numerous other localities are mentioned in the references given, and with the great recent increase of transportation-facilities in Yunnan it is not at all impossible that the gold-mining industry will greatly develop.

Gold is known to occur in Kansu, and there are quartz veins in the upper valley of the Han-ho, in Shensi. Along the lower reaches of the Han-ho, in Hupei, there is a small amount of gold-washing constantly carried on. The same is true of Fukien, where, in the Shao-wu district, 150 miles NW. of Foochow, valuable deposits are said to exist. In Anhwei mines were formerly worked, and deposits are known to exist in Hunan and Kuangsi, but they are not much worked. The mines in Kuangtung are said to be valuable; but in all these cases, it is probable that the deposits are limited in extent and of no great richness. It may be

said, in conclusion, that with the exception of Manchuria and the SW. provinces of China (Yunnan, and Ssu-chuan), the gold-mining industry gives but little promise of growth. In the districts mentioned the introduction of modern pumping-machinery and the removal of the restrictions which the authorities and superstition have placed upon the industry are likely to lead to a considerable development.

V. SILVER.

Silver is of great interest in China, since it is the chief medium of exchange. But the domestic production of silver is small, and China is, accordingly, a heavy buyer of the metal. An interesting subject for speculation is found in the source of supply of this metal during the period when China maintained but little communication with the outside world. About the time of the beginning of the Christian era there was a great deal of traffic with the countries on the SW. border, where the mining and smelting of argentiferous galena seems to have been a considerable industry. The best-known silver-mines are those in the northern part of Chihli province, near Jehol. At the time when Li Hung-Chang was viceroy, foreign engineers were employed in their exploitation. Woo,⁵¹ who has described the native methods of mining and smelting these silver-lead ores, which occur as veins in quartz-porphry associated with Palæozoic sediments, says that the lack of success of the foreign enterprise was due to the high cost of the coke used and to the unsuitable character of the milling-machinery employed. The general and probably correct impression is that these veins are too limited in extent and too irregular in character to allow of their being worked with a profit upon a larger scale than that employed by the natives. The production in 1903 was estimated,^{55, 16} at from 80,000 to 100,000 oz. per year. In the mountains to the west of the line of the Peking-Hankow railroad numerous small occurrences are known, but the production is probably insignificant. References to the occurrence of silver-ores in nearly every province may be found, but do not seem to warrant much attention. Duclos¹³ mentions numerous places in Yunnan where silver is produced, being usually associated with lead and zinc. The production at Pei-cha-po he estimated as 10,000 oz., and says that small amounts are produced at 'Koung-chan,' 'Fou-lay-tchang,' 'Siao-in-tchang,' 'Tchou-tsin-tchang,' 'Sin-pao-tong,' 'Ta-lang-tchang,' 'Tchen-pien-tchang,' 'Mo-lay-tchang,' and 'Sin-tchang,' in Yunnan. At Tsai-tse-chang in Kweichow, silver is obtained from an argentiferous galena. At 'Mou-pin,' in Ssuchuan, an argentiferous galena containing a little gold occurs; silver is also found toward the north of the province, at 'Fe-tsoa-pa' and 'Hou-koua-tou.'

On the maps prepared by La Mission Lyonnaise the following places are marked as productive of silver: Ssu-chuan (101° 45' E., 32° 10' N.). Kweichow (104° 20' E., 25° 12' N.), (104° 35' E., 25° 05' N.), (104° 15' E., 28° 10' N.). Yunnan (98° 45' E., 23° 45' N.), (99° 50' E., 23° 20' N.), (101° 0' E., 26° 30' N.). Kwangsi (106° 55' E., 23° 0' N.), (107° 50' E., 21° 30' N.). Kwangtung (108° 20' E., 21° 40' N.), (109° 45' E., 22° 20' N.), (110° 50' E., 25° 10' N.), (111° 0' E., 24° 50' N.), (111° 05' E., 22° 20' N.), (112° 15' E., 22° 50' N.), (114° 50' E., 23° 25' N.), (114° 05' E., 24° 15' N.). A Chinese company is now mining silver at Kwei-Hsien, in Kwangsi. The Jun Wah Sut Yip Co. was organized a few years ago with native capital to develop silver and other mines in Kwangsi, and is carrying on extensive exploration and development-work. Several foreign companies have attempted the development of silver-mines in southern China, but without much success. It must be admitted that, on the whole, silver-mining in China is of no great importance.

VI. COPPER.

Copper has always been an important metal in China, brass and bronze, used for objects of use and adornment and as media of exchange, having played a prominent part in the national

life from the earliest times. But in the case of copper, tin, nickel, zinc, and lead, the discussion of the metals separately offers difficulties, since the ores are associated and are often smelted together, giving rise to natural alloys. By far the most important supply of these metals is derived from the southwest. Yunnan is the most important, but copper also occurs in the neighbouring regions. Duclos¹³ gives a long list of places where copper is produced in Yunnan, and describes in some detail the work at San-Kia-Chang (99° 35' E., 24° 40' N.), where he estimated a yearly production of 42 tons. Le Clere²⁵ has summarized as follows:

"The total production obtained by reduction with charcoal was, in the 17th century, at least 6,000 tons, but has decreased to from 1,000 to 1,500 tons. The decrease is not due to the impoverishment of the deposits, but to the disappearance of the forests, the scarcity of fuel permitting only the exploitation of deposits of unusual richness at the places most favourably situated in respect to transportation. The copper minerals are various. Phillipsite, cantonite, and more rarely cupriferos pyrite, are found in veins in the Carboniferous schists, but are almost abandoned. Sheets of cuprite with barite, and of native copper, intercalated in porphyry, are highly esteemed, but the lack of explosives often makes it impossible to work them. Sandstones impregnated with copper carbonate are often found in the Trias. The principal deposits are in Triassic limestones, the network of veins have been converted into carbonates, with only a trace of pyrite. The principal mining centers are: (1) 'Toung-tchouan' (101° 0' E., 26° 30' N.), the mines in Ssu-chuan, near the Blue river are connected with these; (2) 'Oni-si,' near Li-Kiang (97° 15' E., 27° 15' N.); (3) the neighbourhood of 'Ouei-ning' (102° 15' E., 26° 45' N.) in Kweichou produces zinc and lead principally, and is directly governed by the mining official of Yunnan-hsien. The works will not take ores of lower grade than will give a smelting mixture of from 20 to 30 per cent. of copper; the latter is more common. This richness is obtained by careful hand-sorting at the mines. The ores lower in grade than 15 per cent. are piled up and form large dumps. The old slag-dumps are common near the old smelting centers and contain about 3 per cent. of copper. These facts demonstrate that Yunnan has extremely large resources of copper minerals, especially in the parts not workable by native methods."

The present chief source of supply from Ssu-chuan, according to Fox,⁵⁸ is at Hwei-li-chan, though an important mine exists at Pai-shui-ho.

Copper occurs in many other parts of China. While in Kiangsi in 1908, the local officials told me of a large copper-mine at Chang-pai-ling in the west-central part, which had recently been extensively developed, but was not successful. Clark⁴ has described the copper-ore at Lao-Pao-chi in Anhwei; this is probably the area which was subsequently granted as a concession to Sir Lister Kaye. Considerable work was done upon this concession by the English company, but without conspicuous success, and in 1910, the concession was surrendered. Clark⁴ also describes the production of copper by native methods near Jehol (118° E., 40° N.), and I have seen unimportant native workings in many other places. C. H. Hansen, who has recently been engaged in the work of constructing a 50-ton copper-smelting plant under government auspices at Yaokai, 70 miles west of Lan-chow, on the western border of Kansu, says that there are numerous mines within a radius of 80 miles from that point.

The mining of copper has always been rigorously under the control of the government, probably because of the importance of the metal as a medium of exchange. The native supply has not been equal to the demand recently, and considerable amounts are imported, chiefly from Japan.

VII. NICKEL.

Nickel is of much technical interest because of the ingenious way the Chinese have of smelting mixtures of nickeliferous copper-ores with tin, lead, and zinc-ores, forming the alloy "pai-tung," or "pakfong," as it is called in southern China. This is a kind of German silver, which is extensively used in the manufacture of candlesticks and other household objects. Nickel is never produced separately, and the entire supply is apparently drawn from southwestern China, where in Yunnan (at 100° 20' E., 26° 50' N.), and in Ssu-chuan (100° 20' E., 26° 45' N.), Duclos¹³ has noted the occurrence of nickeliferous copper-ores.

VIII. TIN.

China is an important producer of tin, furnishing at present about 5 per cent. of the total production of the world. A certain amount of

the product comes in native boats down the Yuen and Hsiang rivers, probably originating at some point in Kweichou. Kwangtung also produces a notable amount, which is exported through Wuchow. On the maps prepared by La Mission Lyonnaise the following places in Kwangsi and Kwangtung are marked as productive of tin: (105° 10' E., 24° 12' N.), (110° 15' E., 24° 45' N.), (110° 45' E., 32° 15' N.), (112° 0' E., 23° 30' N.), (112° 45' E., 22° 50' N.), (114° 10' E., 23° 40' N.). There are also deposits in Fukien, and a small amount is shipped from Foochow. But by far the larger part of the production comes from the well-known mines at Ko-ch'iu-ch'iang (100° 50' E., 23° 20' N.), in Meng-tze-hsien, Yunnan. Here the deposits, which LeClere²⁵ says "ne sont nullement alluvionnelles; leur origine filonienne est des plus évidentes," are scattered over an area 25 miles long and 20 miles broad, and 30,000 workers are engaged in mining and smelting the product of 150 miles. The workings are both surface and underground and only native methods are employed. Collins,⁶ Duclos,¹³ and LeClere,²⁵ have described these deposits in detail. Theoretically the deposits belong to the central government, which, according to the mining-regulations, exacts a royalty of 25 per cent., but the amount actually paid is somewhere between 12.5 and 18 per cent. The reports as to the production of these mines do not agree, but the customs return for 1909 was 4,700 tons, corresponding to about 90 per cent. of the total production for the country. The crude tin, in slabs, each weighing 74 lb., is exported to Hongkong, where it is refined. A large part of the tin was formerly shipped down the Yang-tze and West rivers, but now it is shipped over the French railroad. Recent newspaper reports are to the effect that efficient smelting and mining-machinery is to be installed, about \$1,200,000 having been subscribed for the purpose, and the erection of a slag-cleaning plant has been proposed. It is not unlikely, therefore, that the production of tin in China will considerably increase in the near future.

IX. LEAD.

There is a considerable demand for lead in China, which is largely met by imports, 10,707 metric tons of pig-lead having been imported in 1908. The domestic production is not inconsiderable, lead-ores occurring in 8 of the 18 provinces; Kweichou, Ssu-chuan, and Yunnan are the most important; but about 1,500 tons of ore were derived from Hengchou and Yangchou prefectures, in Hunan province, in 1908. The larger part of this is exported to Great Britain and Belgium, but considerable quantities are smelted at the works of Carlowitz & Co. at Wu-chang. About 350 tons of pig-lead was brought down the Yangtze through I-chang in 1907, and 300 tons in 1909. A good deal of lead-ore comes down the Yuen and Hsiang rivers, both from Hunan and Kweichou. Duclos¹³ has described the production of lead at 'Tcha-tze-tchang' (102° 50' E., 26° 45' N.), in Kweichou, and notes its occurrence at (102° 40' E., 26° 30' N.). In Yunnan the mines contain mixed ores of lead, zinc, copper, and silver. In the neighbourhood of 101° 0' E., 26° 30' N., at 'Kong-Chan-tchang' 1,450,000 lb. of lead is produced, at 'Pe-cha-po', 700,000 lb. of lead, at 'Koung-chau' the lead produced is cupelled for silver. Near 102° 20' E., 26° 45' N. there is a considerable production, both of lead and zinc. In many places argentiferous lead-ores are worked (see "Silver"), the bullion being cupelled; the resulting litharge often being thrown away. LeClere²⁵ estimated the annual production in southwestern China at around 3,000 tons. The lead-ores of Kwangtung and Kwangsi are mentioned under "Silver." On the maps prepared by La Mission Lyonnaise the following points in Kwangtung are marked as productive of lead: (109° 50' E., 21° 58' N.), (110° 15' E., 23° 57' N.), (114° 05' E., 23° 58' N.). The native methods of metallurgy are so imperfect that it is not improbable that in many cases deposits exist which could be worked by modern methods. But, as mentioned under Silver, it has not infrequently been found that the veins are too narrow and irregular to yield a profit when exploited on a large scale.

X. ZINC.

The whole domestic supply of zinc in China is derived from the SW. provinces, chiefly Kweichou. Duclos¹³ has described the native metallurgical methods followed at 'Ma-lou-kio' (102° 50' E., 26° 45' and mentions the occurrence of zinc in Yunnan at (102° 20' E., 26° 45' N.) and (101° 40' E., 25° 30' N.). LeClere²⁵ says that the workings are only superficial, and that the distillation-methods are imperfect that much ore which could be utilized by modern method has been discarded. He estimated the annual production at about 2,500 tons. The spelter from Kweichou, which I have seen, was obviously impure, but it is used in the provincial mints in making brass coins, without any attempt at refining. Large quantities of zinc-ore are produced in Heng-chou and Yang-chou prefectures, Hunan, and exported to Belgium and Holland. The export for 1908 was more than 15,000 tons, but for 1909 was very small.

XI. ANTIMONY.

China possesses the distinction of being first in the production of this metal. The condition of the industry has been changing rapidly of recent years. My notes were made on a visit to the chief center of production in 1908. The ore comes from a number of places to NW. of Tung-ting lake in Hunan, I-yang being the chief center, (110° E., 20° N., approximately). It is carefully hand-sorted at the mines, and is brought in native boats to Changsha (112° 45' E., 28° 15' N.), where it is liquated in pots about 15 in. in diameter. The methods were entirely Chinese at that time, but I understand that furnaces of modern construction have since been installed. The regulus is sent to Hankow, and so much as desired is converted into metal. The residues have been exported to France, Germany, and the Netherlands for further treatment; more recently large quantities have been sent to the United States. Carlowitz & Co., who operate a smelter at Hankow, are also engaged in the work of smelting and refining both antimony and lead, but as strict secrecy is observed, details are not obtainable. The production for 1907 from this district in Hunan, according to customs returns, was 3,057 tons of regulus and 14,810 tons of ore. In 1908 the production of regulus increased to more than 8,000 tons, and the ore-shipments decreased to less than 2,000 tons. The native company which operates the smelter has trained metallurgists in its employ, and the industry is likely to further increase in importance.

Antimony also occurs in Kiangsi, Kweichou, and Ssu-chuan, but Kwangtung is the next most important province after Hunan. Recently a smelter under government auspices was established at Wuchou (111° 30' E., 23° 30' N.), but was not a success, and has since been closed. A more extended discussion can be found in the *Mineral Industry* for 1908 and 1909, and in the volume *Antimony*, by C. Y. Wang (London, 1909).

XII. QUICKSILVER.

Quicksilver has a steady demand in China, most of the metal being used in the production of vermilion, which enjoys high favour as a pigment, a less important use being in gilding by the Chinese method. The native production fluctuates greatly, the amount reported by the customs authorities being, 30 tons in 1907, and 65 tons in 1908. It is impossible to determine what relation exists between the total amount produced and that reported by the customs. Most of the demand is supplied by imports, largely from California. The occurrence of quicksilver is reported from many parts of the country but the deposits in the province of Kuei-chou are, apparently, the only ones of commercial importance. As I have not visited these districts, my information is entirely derived from published statements. Duclos¹³ has noted several places in Kweichou where quicksilver is produced; 'Oa-tchouan' (105° 50' E., 28° 30' N.), Pei-ma-t'ong (104° 15' E., 26° 48' N.), Lan-mou-chang (103° 15' E., 25° 28' N.) and Yang-li (104° 20' E., 15° 0' N.) are the most important. He estimated the production at Pei-ma-t'ong as 6,500 lb. per year, and says that

at Yang-li there is "*une enorme exploitation*." He also mentions the occurrence of quicksilver in Yunnan (101° 10' E., 23° 30' N.). LeClere²⁵ was not favourably impressed by the mercury-deposits, and remarks, accurately enough, that the native methods of work can treat ore of quite as low grade as would be profitable by foreign methods. Brelich³ says that the deposits at Wan Shan Chang, in Toon Yen prefecture, are the largest and most extensively worked in Kuei-chou. They occur in nearly horizontal beds of magnesian limestone: (1) impregnating well-defined beds; (2) along joints and planes of stratification; (3) in isolated bunches and vugs; (4) irregularly disseminated. The ore is hand-sorted and retorted in native furnaces. Brelich says the miners work for daily wage, which is unusual. The Anglo-French Quicksilver & Mining Co. began work at Kwei-yang in 1890, with a capital of £310,000, operating the Wen Shan Chiang mines, which are 12 miles north of the Yuen river. These are apparently the mines which Brelich describes. The area of the concession was 4 sq. miles. Two 12-ton Granitza furnaces were constructed, and the production from 1890 to the end of 1902 was 32,500 lb. of quicksilver and 500 lb. of cinnabar. The company has had a somewhat checkered career, and little progress is now being made.

XIII. ARSENIC.

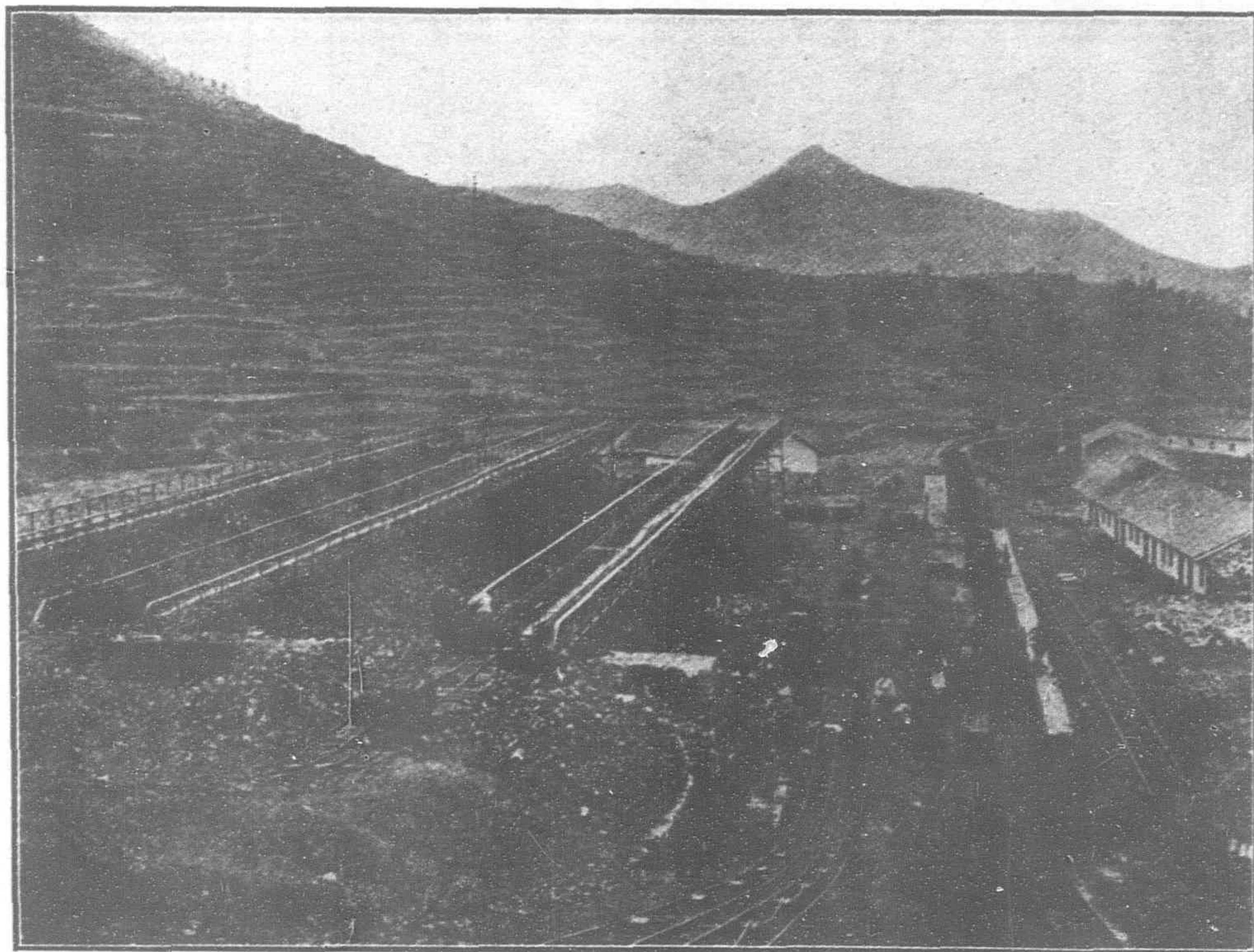
Arsenic is of no little importance in China, but detailed accurate information regarding its occurrence and production is not obtainable. According to the customs returns, 5,000 tons was produced in 1908, but only 400 tons in 1909. Apparently the ore occurs in or near the principal antimony district (111° E., 29° N.), since the product passes through the same custom-house. About 700 tons of arsenic-ore from China was imported into Germany in 1908. A recent French report estimates the annual production of orpiment and realgar in Yunnan at 600 tons. This comes from near Chao-chou and Meng-hua, in Tali prefecture.

XIV. PETROLEUM.

The most notable petroleum-producing district is in Ssu-chuan, where, according to Coldre,⁵ there are in the neighbourhood of Yun-hsien (102° 10' E., 29° 38' N.) and Fu-chuan (102° 43' E., 29° 27' N.) from 30 to 40 wells, from 1,000 to 3,500 ft. deep, in which petroleum occurs associated with gas and brine. The gas is employed in evaporating the brine, and the petroleum, which varies from '*blanc de petit lait*' to '*noir*,' is burned in crude lamps without any attempt at refining. Duclos¹² describes the wells at 'Tse-liou-tsin,' which is between Yun-hsien and Fu-chuan, nearer the latter, giving the number as about 150; but probably this refers to the total number rather than those which actually produce petroleum. But neither gives any estimate of the amount of actual production. Richard⁴³ refers to the occurrence of petroleum in Kansu, but does not give the locality. Recent press reports are to the effect that petroleum has been found near the Kanchou coal mine, in Kansu, but no definite information is available.

A field that is of present importance occurs near Yen-chang (110° 0' E., 36° 30' N.), in Shensi. A native company has been at work there for some years, has recently constructed a refinery, and is now selling oil throughout Shensi in active competition with the foreign product. I have been unable to obtain reliable detailed information regarding this field, but it is probably of a great deal of importance, since it is rumoured that the company is considering the construction of a light railway from the wells to Singan-fu, 200 miles distant. Apparently, petroleum occurs only in the western and SW. parts of the Empire, but in these places a considerable native industry is likely to develop when the areas are provided with adequate transportation-facilities.

In concluding this paper, it should be added that the development of the mineral resources of the Chinese country would be greatly aided by the creation of a country Geological Survey. The nucleus of such an organization already exists in the many Chinese geologists and engineers who have been trained abroad,



LOADING PLANT AT TA-SH1H-MEN, TAYEH IRON MINES

and with proper organization and sufficient funds, this important and necessary work would redound to the immense benefit of the mineral industry.

[Bibliography will be found on page 99.—Ed.]

THE LOCOMOTIVE WORKS OF HENSCHEL & SOHN AT CASSEL.

The Locomotive and Machinery Works of Henschel and Sohn at Cassel (Germany) were founded in the year 1817 by Anton Henschel, Hessian Chief Mining Engineer, and at first constructed Steam Boilers, Pumps, Turbines (Henschel Turbines) Steam Engines, Blast Engines, Portable Steam Engines and Iron Structures of every description. Several of their design proved specially successful, and gained the firm in its earliest days a good reputation.

The first Locomotive was built in the year 1848, since when the attention of the works has been turned more and more to the construction of locomotives. The 7,000th engine was completed in 1905, the 8,000th in 1907, and the 9,000th engine in 1908.

From their foundation, the Works have remained in the possession of the Henschel family. They have passed down from father to son for four generations. The present proprietor is Mr. Karl Henschel, who has largely extended and modernised the workshops.

With a capacity of more than 700 locomotives per annum the Henschel Locomotives Works are the largest of their kind in Europe.

The number of workmen and officials amounts to 6,500.

Locomotives of all sizes and gauges are built, viz: for main and branch Lines, Tramways, Colonial, Industrial and Portable Railways, as well as for Contractors; also Crane Locomotives for both shunting and unloading Waggon, Locomotives without Firebox, Electric Locomotives, Rotary Snow Ploughs and Steam Motor Cars on special designs.

Those types of Engines that are frequently required are kept in stock or can be supplied at very short notice.

Spare parts for Locomotives, such as Boilers, Fireboxes, Flanged Boiler Plates, Steam Cylinders, Wheels and Axles complete, Tyres and so on can also be promptly delivered.

As a speciality the Works construct "Kettler" Nut Presses, which work without any waste of

material. Henschel and Sohn are the largest suppliers of Locomotives to the Prussian State Railways, and their Engines have been exported in considerable numbers to Russia, Italy, France, Roumania, Servia, Denmark, Turkey, Egypt, the Argentine Republic, Brazil, Chili, Mexico, Japan, China and to other countries.

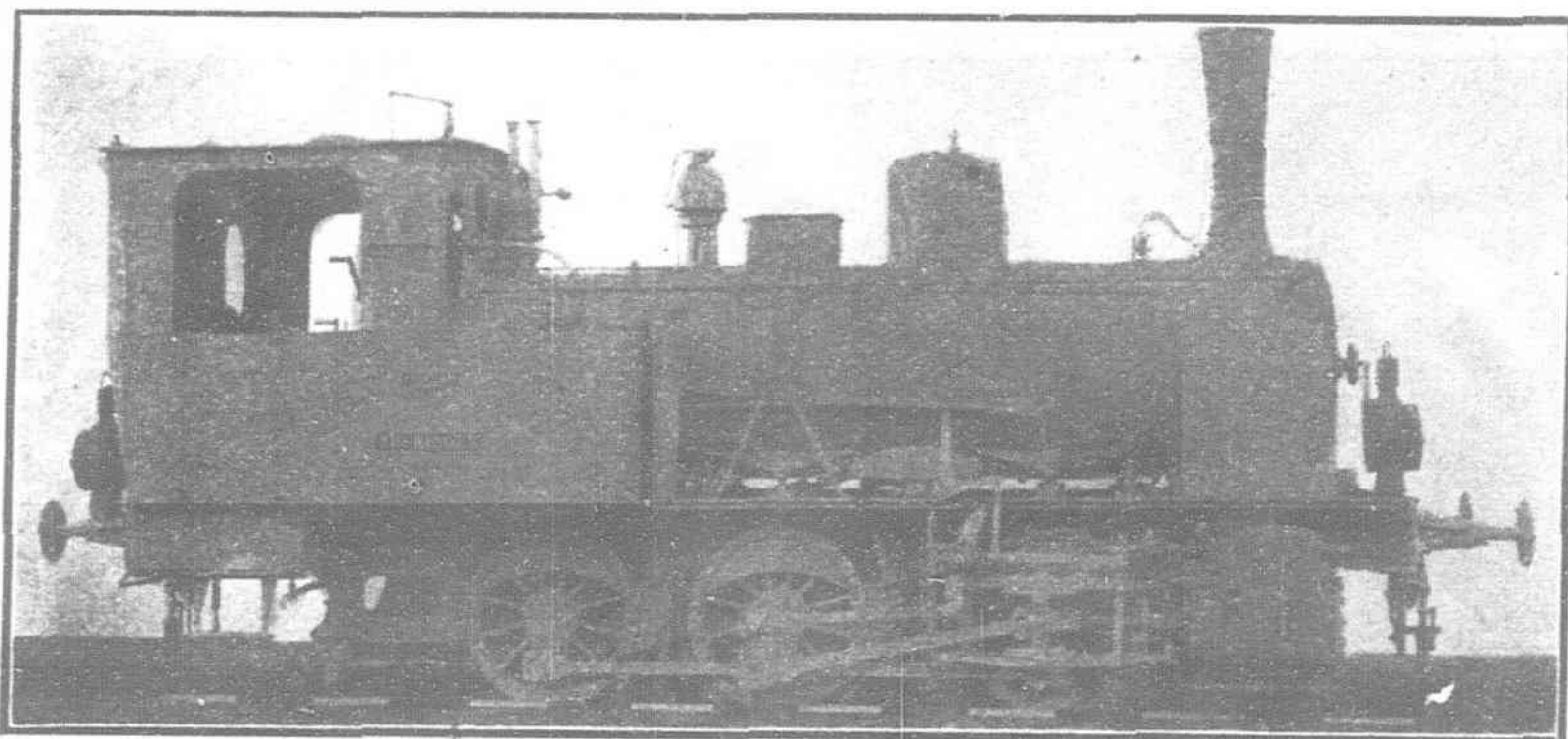
Numerous Locomotives have also been supplied to German and other Colonies in Africa and Asia. The majority of these Engines represent types created by the firm, and are specially adapted to the conditions in those countries, where they have given great satisfaction.

The firm employs a staff of over 150 skilled engineers and draftsmen, who are ready at all times to prepare new designs of Locomotives. Henschel and Sohn do not, however, confine themselves to the construction of Locomotives of their own special types, but build to any design and specification that may be submitted to them.

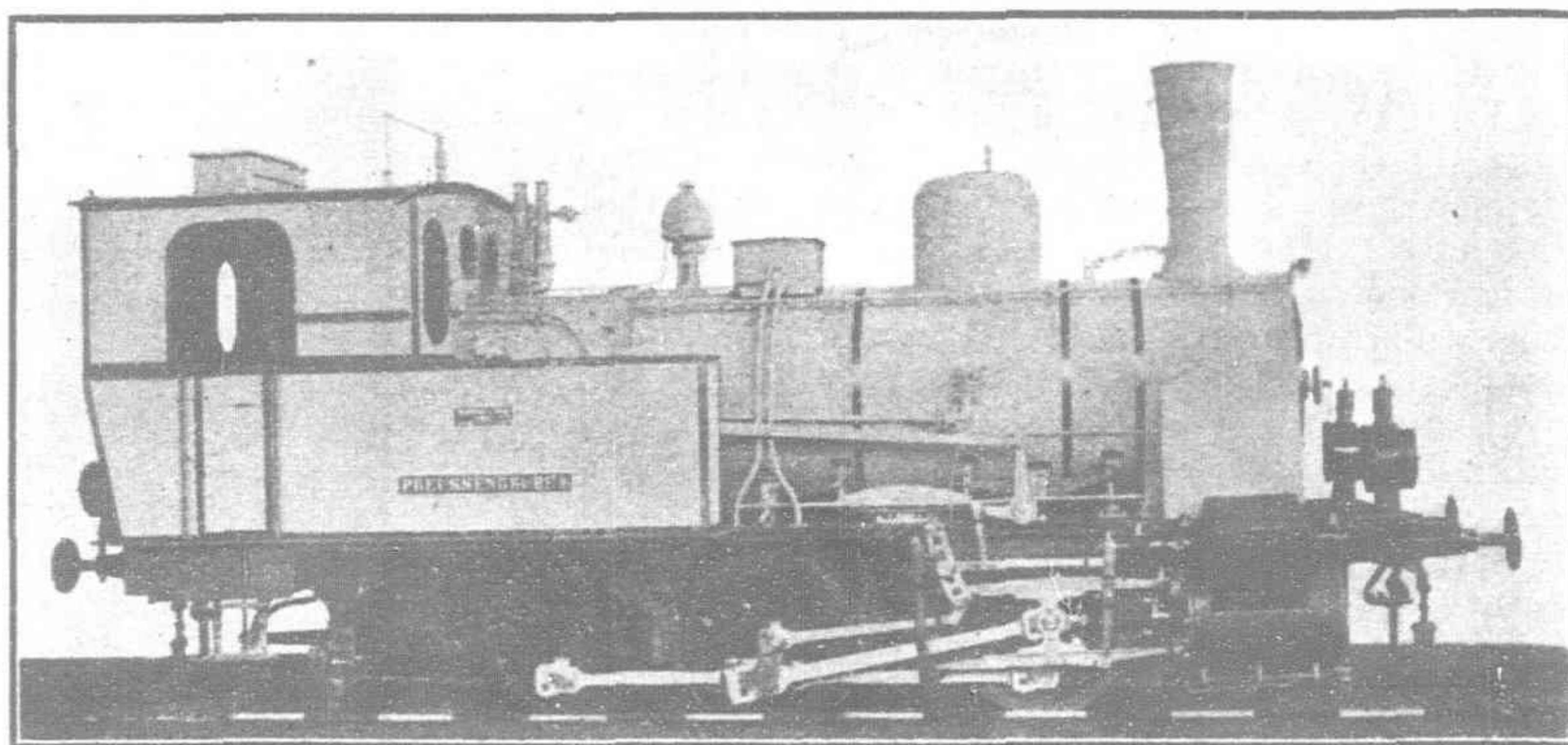
The Engines built by the firm are preferred by many purchasers on account of their practical design, suitability to the conditions of permanent way, and extremely solid and careful workmanship, in consequence of which great durability and a very small cost of maintenance is guaranteed. The finish of the boilers, and the arrangement of the steam distribution in particular are considered perfect and ensure the most economical and complete combustion of the fuel.

The Workshops at Cassel cover two sites, situated in different quarters of the town, but connected with each other by rail. The Shops are supplied with power and light by two Electric Power Stations with an aggregate of 5000 HP. 400 Electromotors drive the Machine Tools, 40 Travelling Cranes, 60 Turning Cranes, 20 Elevators, 4 Traversers and 20 Turntables. The Boiler Shop is equipped with 2 hydraulic flanging presses, 8 hydraulic and 2 electric rivetting machines, partly stationary, partly portable. The Boiler and Erecting Shops are furnished with powerful compressors for driving tools actuated by compressed air. The Workshops also contain 40 annealing, welding and hardening furnaces and 300 Forges. The smithies are fitted with 35 steam hammers with drop weights up to 4½ tons. All steam cylinders, iron and metal castings required for the engines built by the firm are supplied by its own foundries. There are also shops for

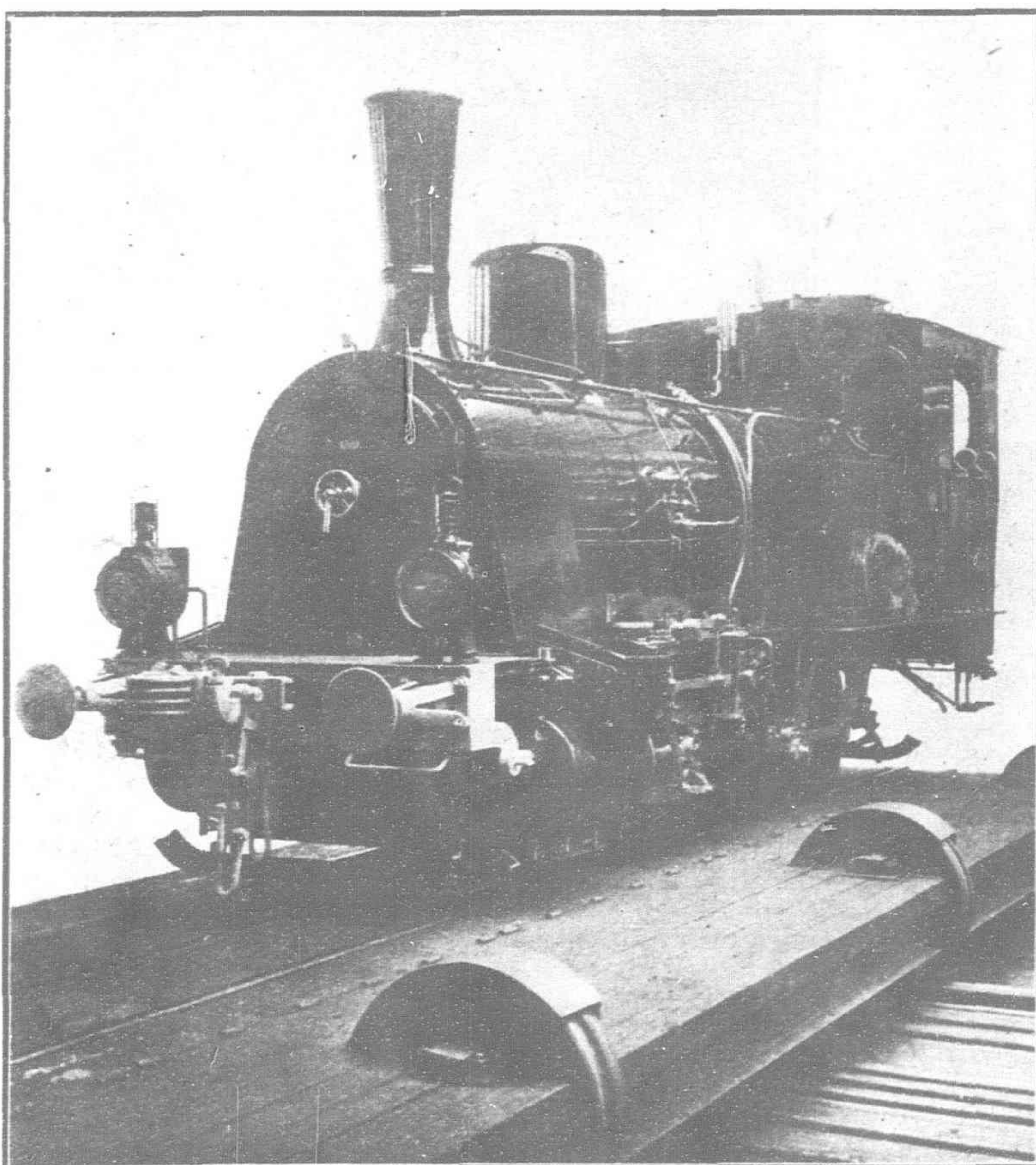
TYPES OF GERMAN LOCOMOTIVES IN USE ON CHINESE RAILWAYS, FROM THE WORKS OF HENSCHEL & SOHN, CASSEL



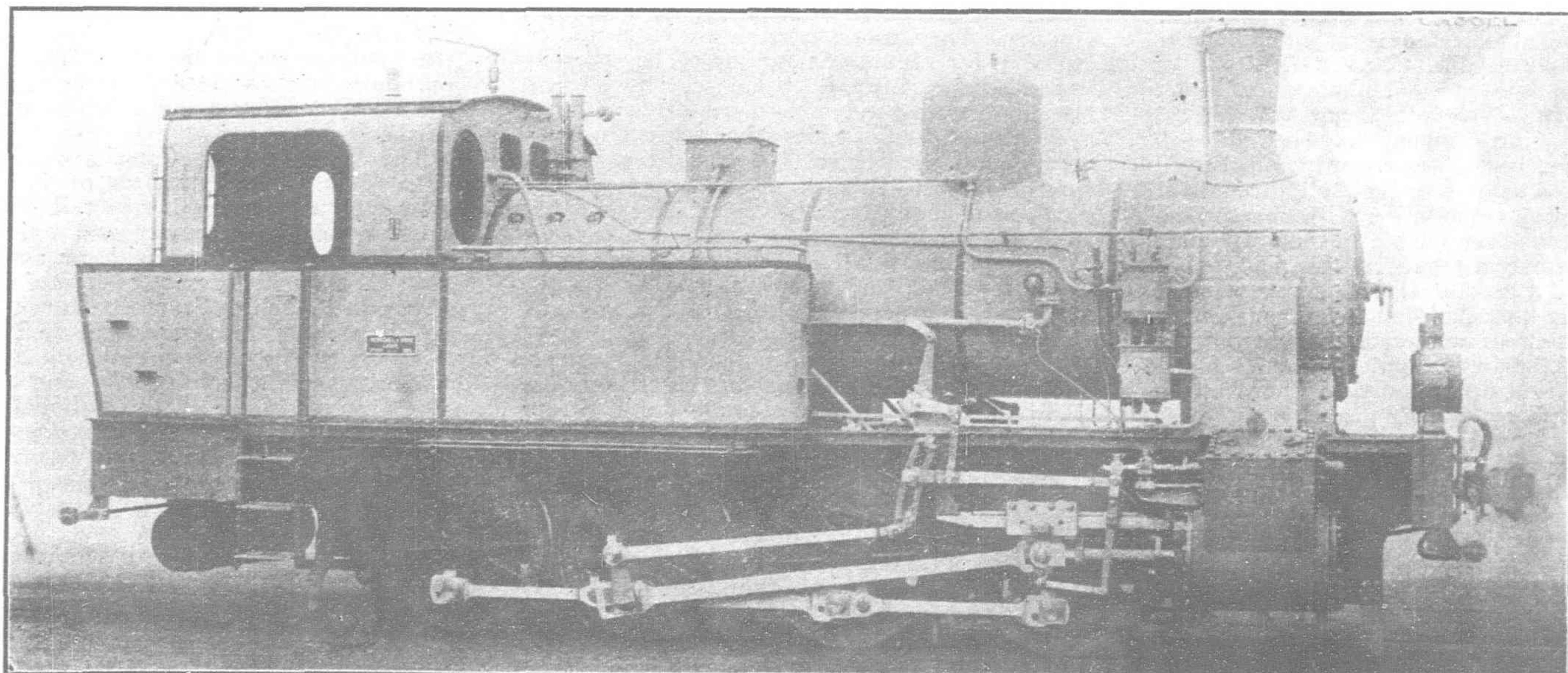
SIX-WHEEL COUPLED TANK LOCOMOTIVE, BUILT BY HENSCHEL & SOHN,
FOR THE HANYANG IRON & STEEL WORKS



SIX-WHEEL COUPLED TANK LOCOMOTIVE, BUILT BY HENSCHEL & SOHN,
FOR THE SUNNING RAILWAY, CHINA

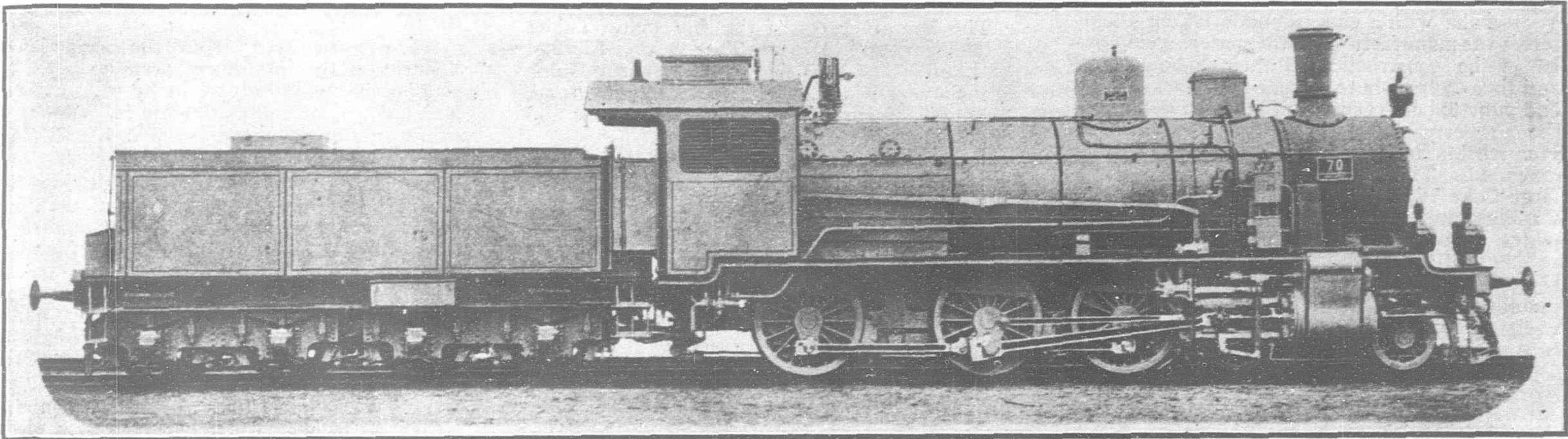


TANK LOCOMOTIVE, BUILT BY HENSCHEL & SOHN, FOR THE TIENTSIN-
PUKOW (TSIN-PU) RAILWAY, NORTHERN SECTION



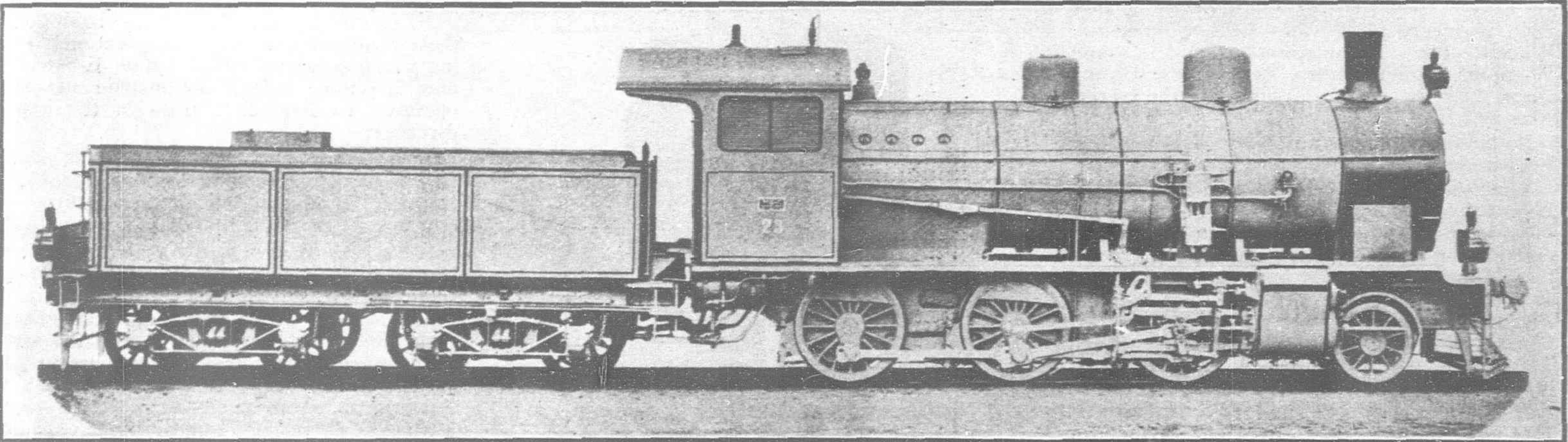
TANK 0.8.0. LOCOMOTIVE, BUILT BY HENSCHEL & SOHN, FOR THE KAINGSU RAILWAY

TYPES OF GERMAN LOCOMOTIVES IN USE ON CHINESE RAILWAYS, FROM THE BERLINER MASCHINENBAU, A.G.
FORMERLY L. SCHWARTZKOPE, BERLIN



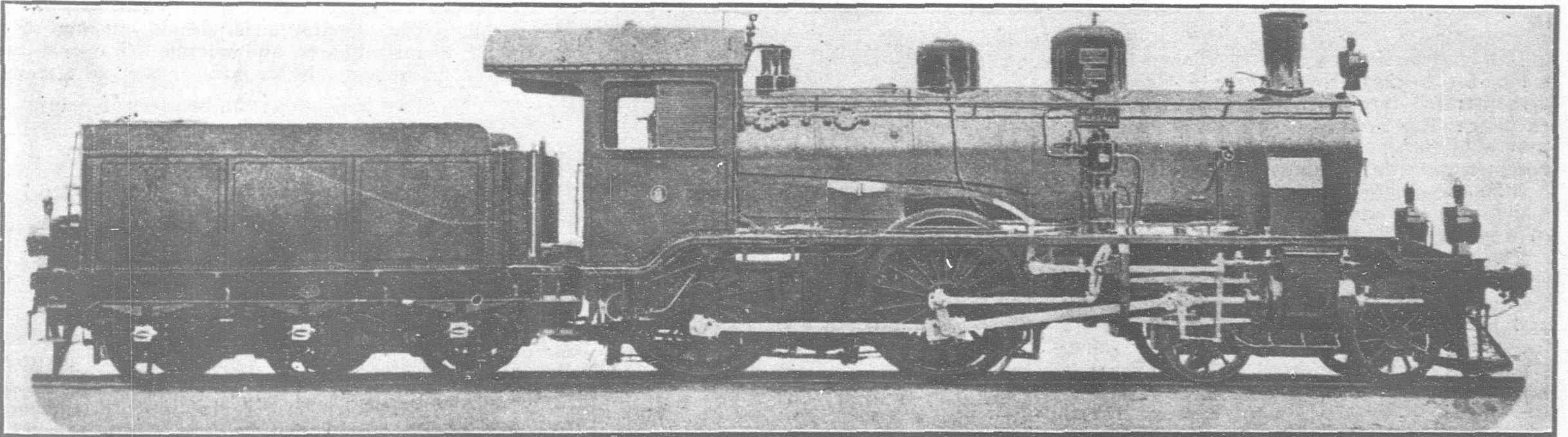
4-6-0 GOODS LOCOMOTIVES FOR THE SHANTUNG RAILWAY (CHINA)

Gauge	8½"	Firebox heating surface	141,5 sq. ft.	Tender:	
Diameter of cylinders.. ..	19¾"	Boiler Tubes heating surface ..	1,565,0 " "	Diameter of wheels	93¾"
Stroke of pistons	24¾"	Total heating surface.. .. .	1,706,5 " "	Total wheel base	15' 5"
Driving wheels diameter	53½"	Weight empty	110,200 lbs.	Water capacity	3,520 ga.
Rigid wheel base	12' 5½"	Weight in working order	123,000 "	Coal capacity.. .. .	8,800 lbs.
Total wheel base	23' 5½"	Weight on driving wheels	92,700 "	Weight empty	49,600 "
Working pressure	170 lbs/sq. in.	Tractive force maximum	23,200 "	Weight in working order	93,600 "
Grate area	26,5 sq. ft.				



2-6-0 GOODS LOCOMOTIVE FOR THE TIENSIN-PUKOW RAILWAY

Gauge	4' 8½"	Firebox heating surface	146 sq. ft.	Tender:	
Diameter of cylinders	19¾"	Boiler tubes heating surface ..	1,740 " "	Diameter of wheels	39¾"
Stroke of pistons	24¾"	Total heating surface	1,886 " "	Total wheel base	17' ¾"
Driving wheels diameter	53½"	Weight empty	116,000 lbs.	Water capacity	4,400 gal.
Working pressure	185 lbs/sq. in.	Weight in working order	132,800 "	Coal capacity	14,300 lbs.
Rigid wheel base	13' 1½"	Weight on driving wheels	105,900 "	Weight empty	43,905 "
Total wheel base	20' 8"	Tractive force maximum	25,150 "	Weight in working order	102,100 "
Grate area	28 sq. ft.				



4-4-0 PASSENGER-LOCOMOTIVE FOR THE CHEKIANG RAILWAY (CHINA)

Gauge	4' 8½"	Firebox heating surface	109,5 sq. ft.	Tender:	
Diameter of cylinders.. .. .	18½"	Boiler tubes heating surface ..	1,150,0 " "	Diameter of wheels	39¾"
Stroke of pistons	23¾"	Total heating surface	1,259,5 " "	Total wheel base	10' 10"
Driving wheels diameter	60"	Weight empty	103,000 lbs.	Water capacity	2,640 gal.
Rigid wheel base	8' 6¾"	Weight in working order	113,500 "	Coal capacity	11,000 lbs.
Total wheel base	24' 3¾"	Weight on driving wheels	70,600 "	Weight empty	35,700 "
Working pressure	170 lbs/sq. in.	Tractive force maximum	14,400 "	Weight in working order	73,200 "
Grate area	24,7 sq. ft.				

making Tools, Cutters, Spiral Drills, Taps, Files, Nuts, Screws and Bolts. In February 1904 Henschel and Sohn purchased the Henrichshuette Works near Hattingen in Westphalia with a view to undertaking themselves the manufacture of the material employed in the construction of their Locomotives, and thus to be able to ensure first class quality and punctual delivery. Since they have become the property of Henschel and Sohn, the Henrichshuette Works have been considerably extended. There are now 2 blast furnaces, a large Coke Works, a large Martin Steel works, a rolling mill for all sorts of thick and thin plates, combined with Flanging presses, 1 rolling mill for Boiler Tubes and Gas Pipes, a shop for bent Pipes of every description, puddling furnaces, a Steel Foundry, a Forge equipped with powerful hydraulic presses and heavy Steam Hammers, 1 rolling mill for Tyres and Wheel Discs, spacious mechanical workshops with the most up-to-date equipment for finishing Engine and Waggon Wheels and Axles, and Steel Castings and Forgings required by ship-building yards and Engineering Works, a shop for the manufacture of electric welded and rivetted drums, combined with a Galvanizing Department, and a factory for making scoria stones.

The Henrichshuette Works employ about 3,500 officials and workmen. The principal products of these Works are:

Plates of all quantities and sizes, Steel Castings and Steel Forgings of every description and of the largest dimensions required by Locomotive Works, Ship-building Yards and Engineering Works, Axles, Tyres and Wheels for Locomotives, Tenders and Waggon, Boiler Tubes, Bent Pipes of any shape, Gas Pipes, Iron Castings of the largest sizes and Iron Drums.

Both Works possess a number of Benevolent Institutions.

For the officials and workmen of the Locomotive Works there are the following (besides the compulsory institutions, such as the sick fund, the accident insurance fund, and the old age and invalids insurance fund) viz: a pension fund for invalids, widows and orphans of the workmen; a pension fund for officials and their widows and orphans; a fund for helping workmen actively employed who may be in need of temporary assistance, called the "Henschel Fund"; a fund for convalescents; free beds in hospitals. There are further for the employees 456 flats; baths; a dining room; a school for the apprentices of the firm; schools for little children and a large hall for meetings. For the employees of the Henrichshuette Works there are similar benevolent institutions. This Works possesses, however, besides its own hospital, a new home for youths, providing board and lodging for 280 unmarried men, 700 flats for married workmen, a club-house for the officials with rooms for visitors to the Works, a co-operative store, etc., etc.

The introduction of Electric Token Instruments for working Single Line Railways has demonstrated that with fast trains the hand exchange for Tokens causes delay and is a source of danger to the men; therefore, the necessity of an Automatic Exchanger has become necessary, the rate of speed being maintained and adds materially to the elasticity of working single traffic.

The New Zealand Government Railways for some time past have taken up very seriously the question of Automatic Tablet Exchangers, and have now on their Railway Systems no less than 260 Stations fitted up with same. About 450 engines are fitted with the exchanging gear, and about 3,850 exchanges of tablets are made every day with express trains running at a speed of over 45 miles per hour. The percentage of failures to the number of exchanges in a year is only one in a 100,000.

The special features in the construction of this apparatus is the simplicity, its reliability under all conditions of working maintenance being reduced to a minimum, the only part requiring occasional renewal being the rubber

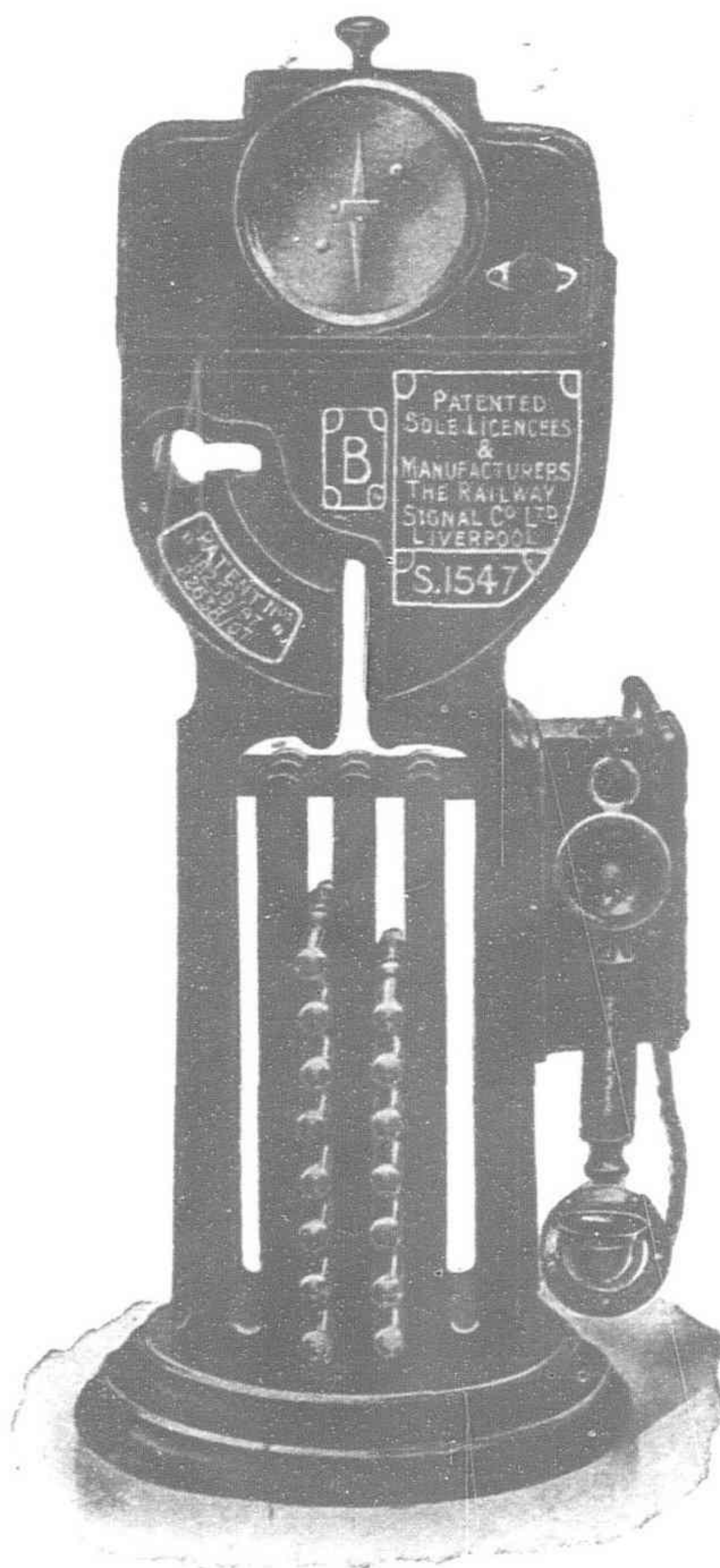
block. The moment the exchange has been effected the arms on the exchanging standards automatically swing clear of the running roads.

The Manufactures of the Automatic Tablet Exchangers are, Messrs. Tyer & Co., Limited of London and Carlisle, whose Agent in China are Samuel & Co., Ltd., 66 Szechuen Road, Shanghai, from whom all information and quotations can be obtained.

The Government have placed an order with Messrs. Tyer & Co., Limited, for a large number of their Single Line Tablet Instruments for Uganda. These Instruments are a combination of Absolute and Permissive Block working, the latter in times of seasonable traffic enabling over 40 trains to be sent consecutively in safety in one direction. They are so arranged that at any time Permissive work can be cancelled and Absolute work be carried out. There are various types, but the main idea is the same in all.

SIGNALLING ON CHINESE RAILWAYS. II.

In our issue for last December, we mentioned some of the safeguards provided against Railway accidents, especially collisions on single tracks.



The original method used for controlling trains on single lines was the train staff. This, then a mere stick, was first employed in the construction of the second Standedge Tunnel on the London and North Western Railway in England, and was first used for lines open for traffic near Leamington, on the same Railway, in the sixties. The train staff became the principal means of operating single lines, and this led to the popularity of the Electrical Train Staff when it was designed in 1889, as by its use the form of token to which drivers were accustomed was retained.

The Electric Train Staff, as originally designed, was of the large type, well suited to the train speed of the day; but, of late years, with the greatly accelerated speed of Express

Trains, the large and heavy type of staff became, of course, a disadvantage, and this led to the development of the present "Miniature Train Staff" now so extensively used.

As will be seen from the accompanying illustration, the instrument occupies but a very small space, being only 7½ in. by 9½ in. and 2 ft 2 in. high. The staffs are all in full view of the operator, and provision is made for the staffs being used uniformly.

For each section of single track there is a pair of instruments, one in each of the signal-boxes or station master's offices, controlling the section. These are joined together by a single line wire. A bell, actuated by the same wire, is provided for each instrument, whereby the men communicate with each other, and no train may enter on to a section of single line unless the driver be in possession of a train staff for that section.

The train staffs may be withdrawn from either instrument when permission is electrically given by the man at the other end, but when a staff is withdrawn, no other staff can be taken out of either instrument until the first staff withdrawn has been placed in the instrument at the other end of the section, or restored to the instrument from which it was withdrawn.

In some countries it is often necessary to start a second train through a long section before the first has arrived at the other end, and for even a third and possibly a fourth. The "Miniature Train Staff System" lends itself to safely controlling train-working under these conditions, without complications; ensuring the due arrival of all trains dispatched in one direction, before the instrument can be operated to dispatch a train in the opposite direction.

The Miniature Staff Apparatus also provides for assisting or pushing engines, for banking trains up an incline, which then return to the entrance of the section and do not go through.

It can also be arranged for a train to be shut into a siding—as for example, a ballast pit—in a section, and for the section to be free for other trains in either direction, without the first train or its engine going through the section. Signals need not be provided at these, or other, sidings on lines protected by Train Staff Apparatus, except where such sidings come at a Station where the Train Staffs are exchanged.

It has already been said that only one line wire is used, and this provides bell communication also; but, it goes still further, as a telephone service is given, in addition, on the same wire.—Special telephones are used, and they remain ready for communication at all times, whether a staff be out or not.

The instruments may also be worked by a magneto generator which dispenses with batteries and makes the system ideal for hot climates where the batteries evaporate or for cold climates where they freeze.

The apparatus is simple, strong, of few electrical parts, and suitable for operation and maintenance by an inferior class of labour.

Two indications can be given, namely:—

Staff in, line clear.
Staff out, line blocked.

or three, namely:—

Staff in, train arrived.
Staff out, train coming.
Staff out, train going.

These indications are given automatically.

When it is desirable to reduce the number of signal boxes that are open, one or more may be closed and the sections lengthened accordingly by a simple contrivance.

The Electrical Train Staff Instrument was invented by that celebrated Engineer Mr. F. W. Webb, in association with Mr. A. M. Thompson, and it may be interesting to know that over 12,000 are in use to-day in all parts of the world.

The apparatus is manufactured by The Railway Signal Company Limited, Caxton House, Westminster, London, S.W.

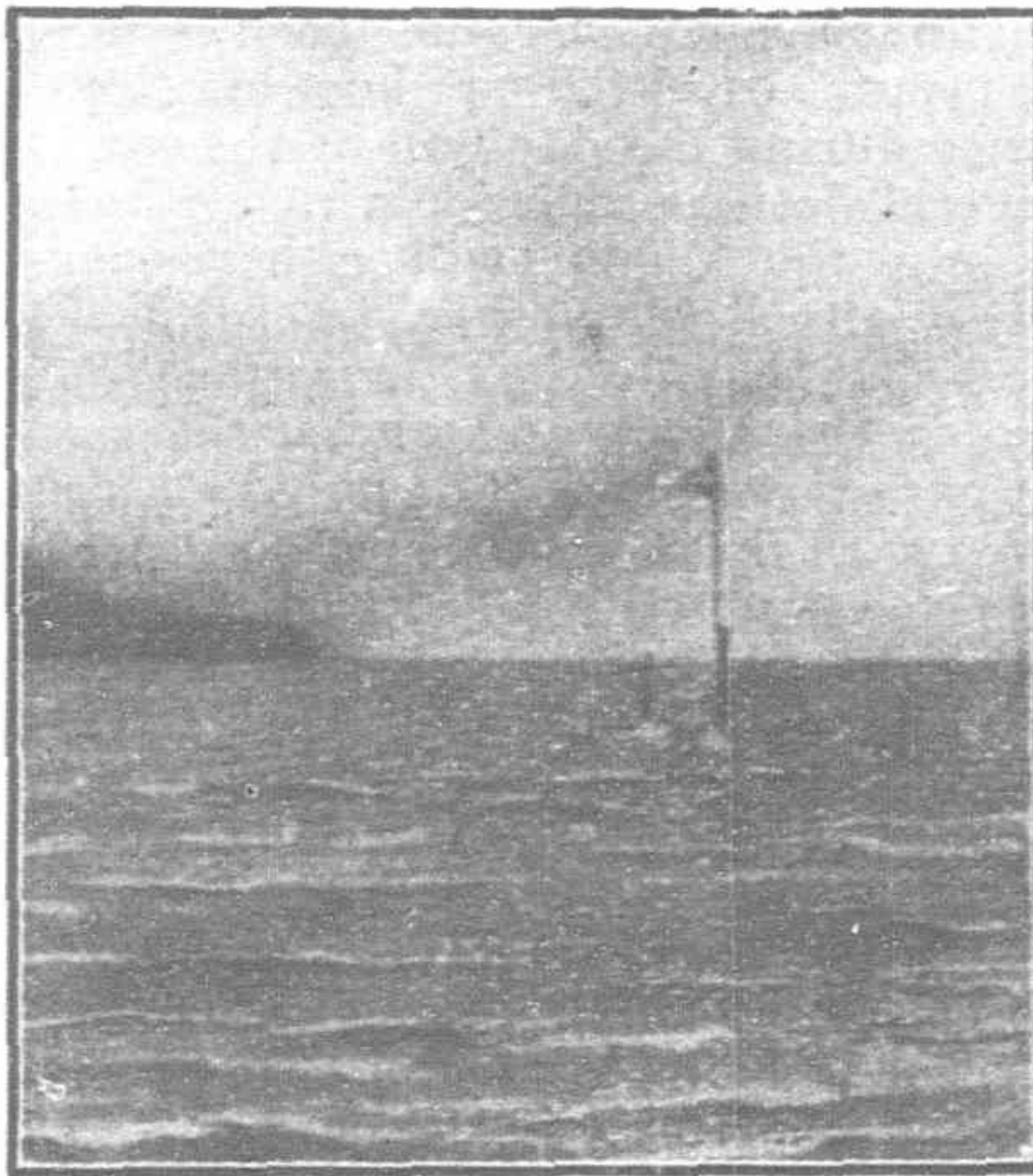
NATIONAL DEFENCE BY SUBMARINES



THE SWEDISH SUBMERSIBLE "HVALEN," CONSTRUCTED BY THE FIAT SAN GIORGIO, SPEZIA, ITALY

There appears to be little doubt that future great Naval Wars will be decided, as in the past, by the conflict of heavy battleships which can seek out the enemy in distant waters and bring him into action. But it seems probable that, in the event of war, the means of defence of comparatively weak Powers would be found to have in recent years rather outstripped the offensive capabilities of the great Navies.

If we regard the history of Naval Warfare from Actium to Tsu-Shima we find, what it must until recently have been regarded as a truism to remark, that the contests between the opposing ships partook of the essential quality of a ship; that is to say, that as the ship could only fulfil her functions on the surface of the water, so all the fighting took place there. It is a notable fact that the two latest developments of the art of war on the marine side, which both refer to defence rather than attack, do not come into this category, but exert their influences respectively one above the surface of the sea and the other beneath it—the airship and the submarine. It is, of course, well known that submarine defence by means of mines dates back to the Crimean War, but this is to be

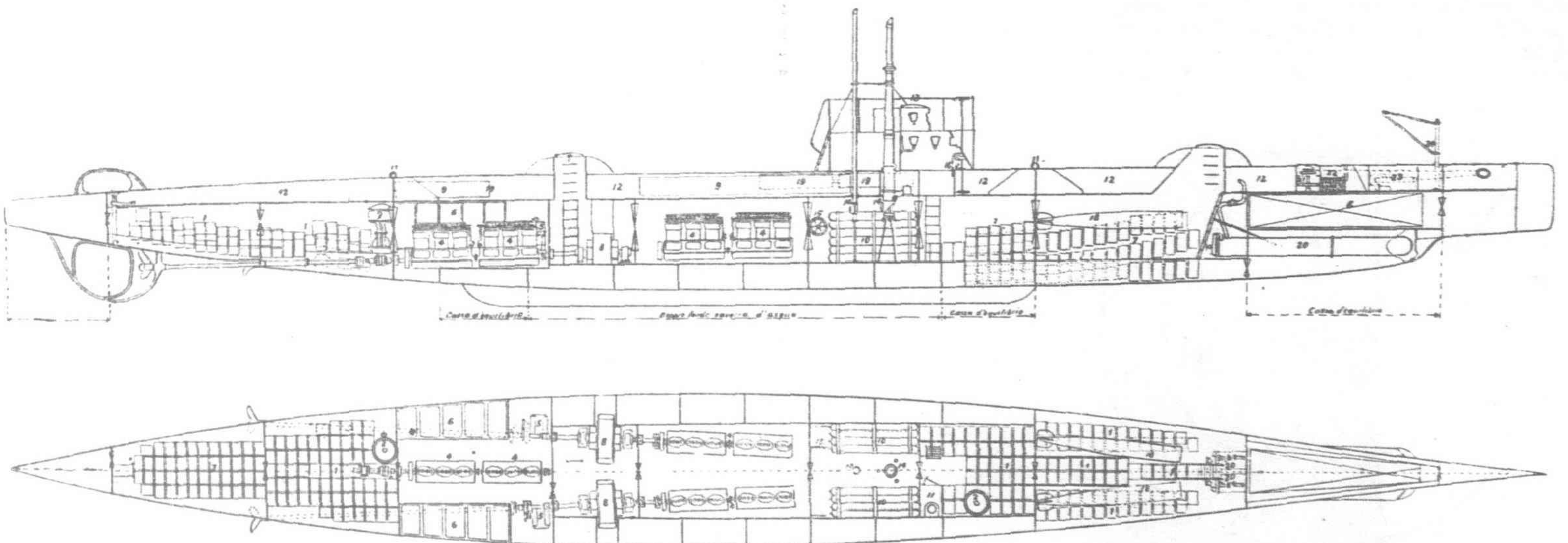


R. ITALIAN SUBMERSIBLE "FOCA" CRUISING UNDER WATER

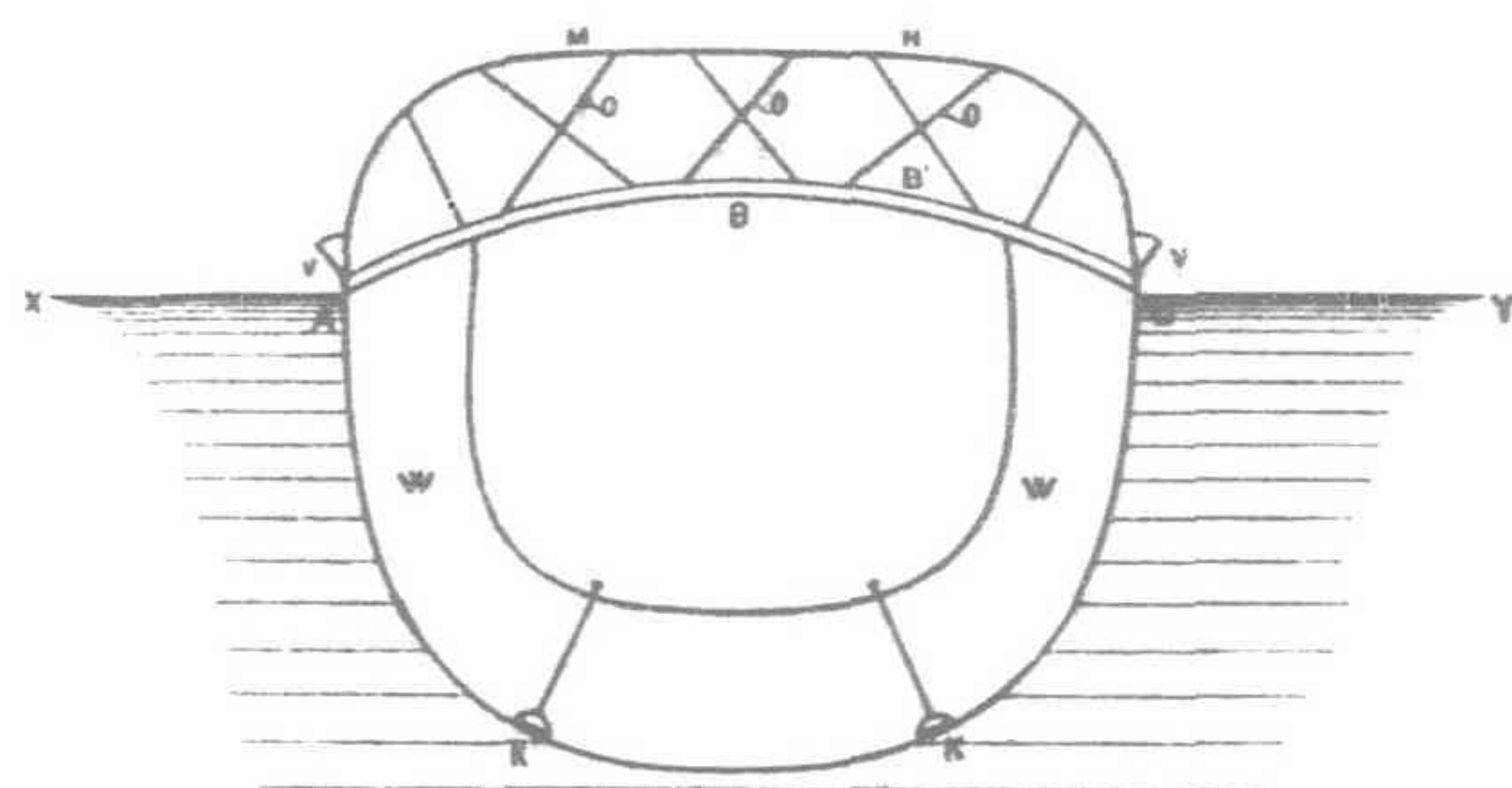
distinguished altogether from attack by submarine ships. The airship may or may not play an important part in future Naval Warfare—that is, as opposed to ships on the surface of the water—but at present its capabilities appear to be confined chiefly to the defensive purpose of scouting.

The submarine, however, has actually arrived and must be regarded as a very important factor in all future Naval Wars, the British Navy having already over eighty of these vessels. In any warfare, efficient means of attack is much the same as efficient means of defence, and in Naval Warfare this is especially the case. Probably the submarine is, in proportion to its cost, the most useful defensive weapon that exists at present.

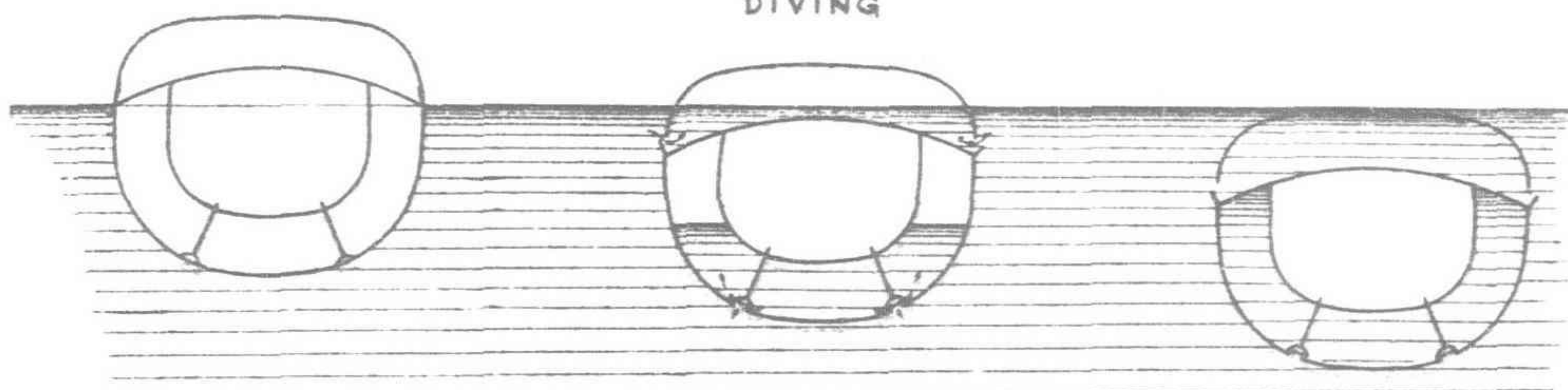
For small States and Colonies which can only expect to repel rather than to seek their enemy, it will probably be by far the best investment, as its cost is so low in comparison with its capabilities. The fact that the employment of submarines exacts perhaps the highest degree of calm courage, with the very smallest allowance of "the fun of the fight," will never act as a deterrent to the brave men of all nations who



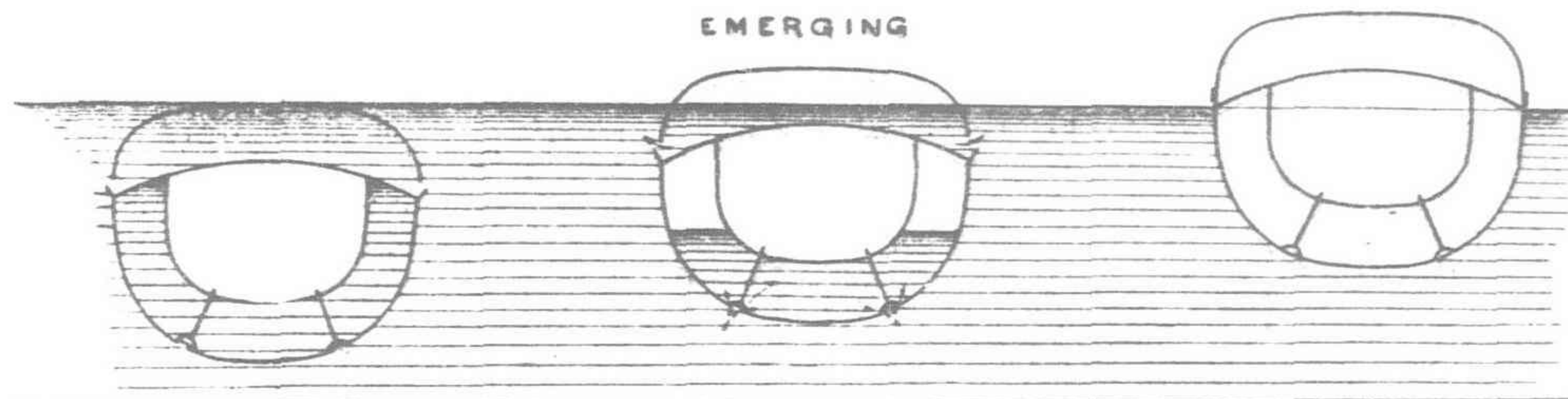
GENERAL ARRANGEMENT OF A "FIAT SAN GIORGIO" SUBMERSIBLE



DIVING



EMERGING



will be called upon to risk their lives on board them. The old days of the cutlass and boarding-pike are gone for ever, and the modern battle, either ashore or at sea, is essentially a cold and less romantic affair than formerly, but demands really a far greater amount of nerve.

The submarine possesses several important advantages over all other torpedo craft. She can attack by daylight, as she is invisible when submerged, her presence being only evidenced by her periscope, a very small object and only noticeable when the boat is at a high speed, which is not necessary when attacking as it is for all other torpedo boats. Her attack takes place when she is either stopped or going slow. This condition affords her officers time to take very deliberate aim, so that the proportion of hits to misses will be much higher than with the ordinary torpedo boat. Another advantage is that while submerged she is protected from gun-fire altogether.

Finally, it is to be noted that the submarine, regarded essentially as a rapidly mobile battery of torpedo-tubes, supplies a modern squadron with a most valuable implement for defending a chosen base of operation. If, for instance, a naval force requires either to coal, or to repair damages sustained in action, or to give the crews a rest, and for one of these purposes

some undefended base has been selected, the sole means of keeping hostile ships at a distance during the day will be the employment of several flotillas of submarines, which, being sent into the offing, will either prevent an enemy's attack altogether, or fulfil the more modest but hardly less important object of retarding the attack and giving the ships time to prepare themselves, thus avoiding a surprise.

Taking all these points into consideration, it cannot be doubted that, if skilfully and courageously handled, the submarine is destined to play a great and novel part in the next Naval War.

Modern Naval War, especially the struggle between Russia and Japan, has very clearly demonstrated the failure of the ordinary torpedo boat as an effective implement of attack at night, for the simple reason that as no human being can see clearly in the dark, it is extremely difficult under these circumstances even to detect a ship, still more so to determine her speed, direction, or nationality. A case in point is the unhappy experience of the Russian torpedo boat which, after a night attack, joined a Japanese squadron and kept company with them till the morning, when both parties recognised their mistake.

In order to make effective practice with torpedoes it is indispensable that the target should be clearly seen, and this is only possible by day. As in the daytime ordinary torpedo craft, especially of the sea-going class, will in all probability be destroyed by the guns of the attacked ship, it has become necessary to devise some more certain means of using the torpedo in broad daylight.

Of all torpedo boats, those most certain in their action either by day or night are submarines, their protection being their power of concealing themselves under water, leaving exposed only a small portion of a periscope through which their officers are able to observe with exactness an approaching ship.

Besides their very doubtful capability of bringing their torpedoes to bear by day, ordinary torpedo craft have another great drawback, viz., that their only efficient protection is high speed; but the higher the speed of the boat at the time the torpedo is discharged, the lower the chance of making a hit, whereas to increase this chance to the utmost is the very *raison d'être* of a torpedo boat.

An ideal submarine torpedo boat would fulfil the following requirements:—

To be as efficient when at the surface as any other good sea-going craft.

To have such accommodation for officers and crew as will ensure reasonable comfort.

The surface speed to be high, so as to enable her to follow a squadron of battleships or reach harbour quickly.

When submerged, to be capable of being kept steadily on her course and to have a very large radius of action at a low cruising speed.

To combine all these requisites with the smallest possible dimensions of hull for the sake of handiness.

We have not mentioned a very high submerged speed, because, the protection and principal characteristic of a submarine being her invisibility, if she goes fast with her periscope out of water this makes such a show that the boat will be easily detected and either avoided or destroyed. The photograph on page 65 indicates how prominently the presence of a submarine is betrayed by her running at a high speed with her periscope up. The tactics of a submarine should resemble those of a shark: she should cruise about at a low speed in the region she has to defend, and discharge her torpedoes when the chosen ship is in the right position.

This system is pretty certain to give a good result, as the commander of a submarine can see the target ship perfectly well by day and has ample time to take, deliberate aim. What different conditions from those under which the gallant commander of an ordinary torpedo boat labours, rushing at full speed on a dark night!

Amongst the many classes of submarines lately built, one type has come prominently to the fore, viz., Laurenti's, built by the Fiat San Giorgio Co. of Spezia.

Constructor Laurenti, having in mind the above principles, has devised a submarine possessed of the following qualities:—

(a) A hull of the form of an ordinary torpedo boat and consequently adapted for a high surface speed.

(b) Great reserve buoyancy while at the surface so as to conform to ordinary sea-going conditions.

(c) High engine power (internal combustion) for surface travelling.

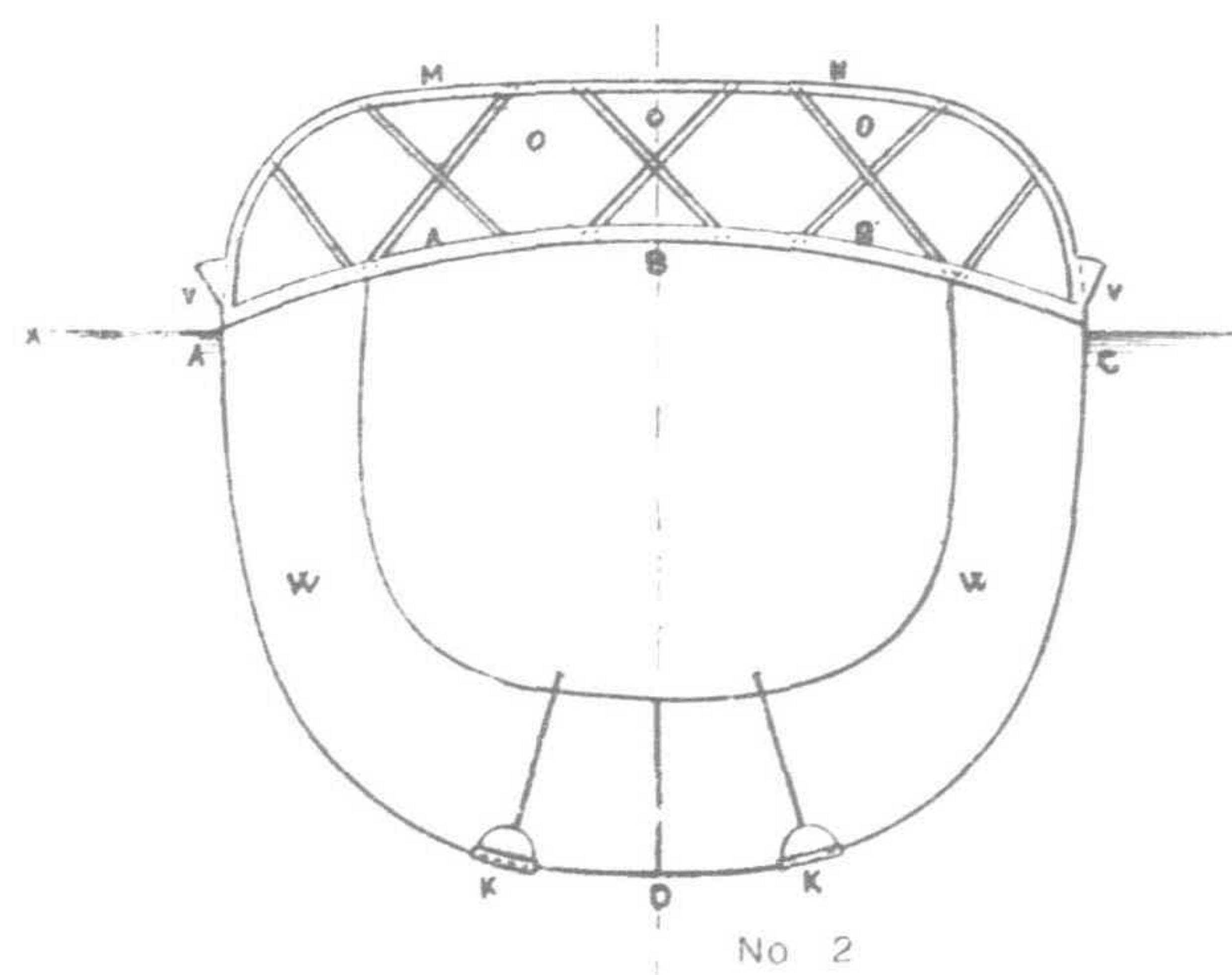
(d) Large oil bunker capacity, affording a great radius of action.

(e) Very moderate draught, a highly important consideration in comparatively shallow waters, such, for instance, as the North Sea harbours.

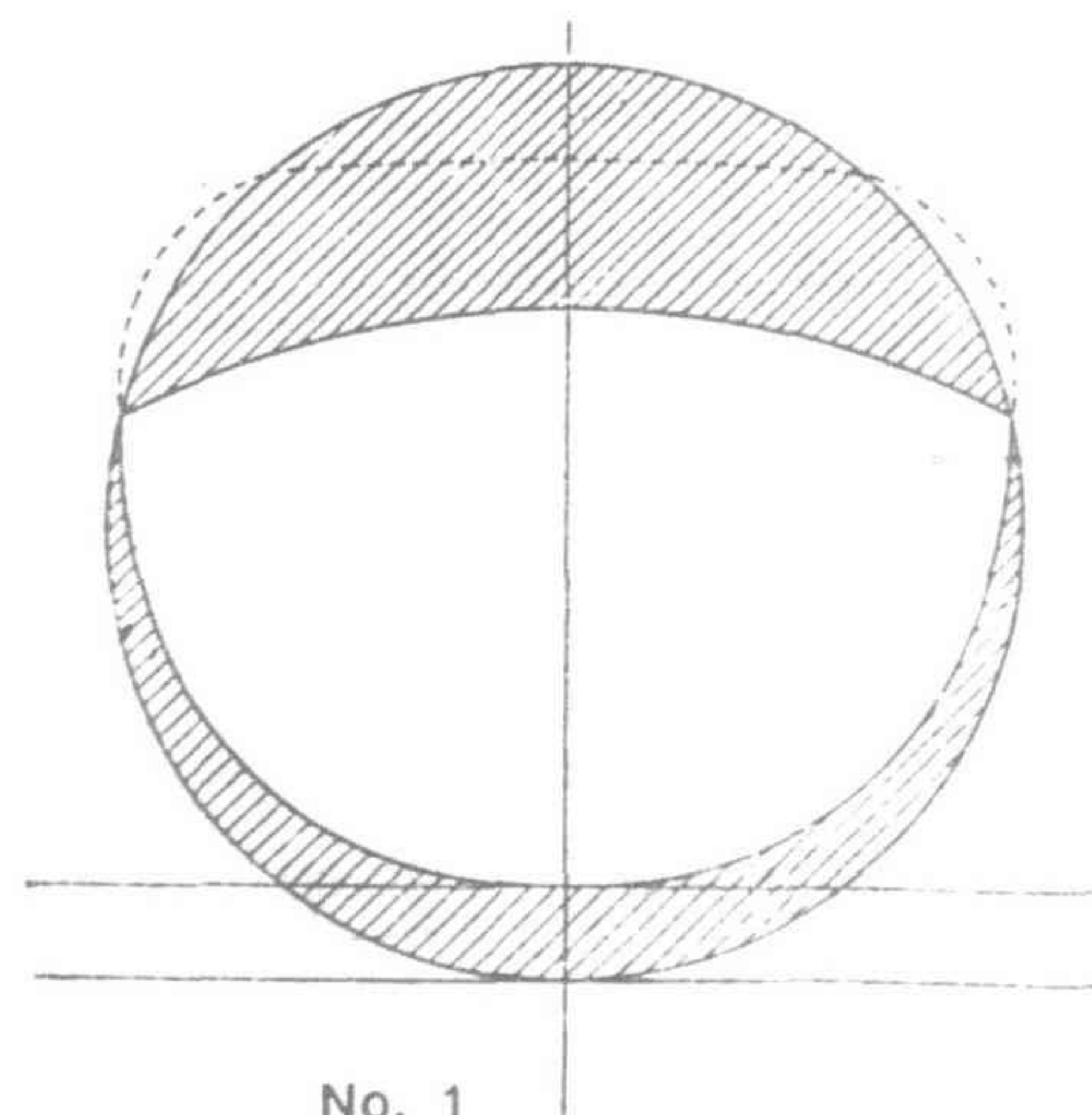
(f) The smallest internal cubic capacity of any submarines in other respects of the same fighting value.

These qualities, besides others to be referred to later on, have been obtained by the special construction of the hull, which is not of the circular section usual in submarines. The midship section is illustrated the beam being just sufficient to afford space for the machiner and the depth to provide head-room for the crew.

For instance, if the breadth necessary for the engines, &c., has been found to be 10 ft., and a



No. 2



No. 1

head-room of 6 ft. 6 ins. is decided upon, the hull will be formed internally to these dimensions, whereas a circular hull would require a diameter of 10 ft., involving a much larger internal cubic capacity. The accompanying sketch No. 1 shows the difference between the two systems, the hatched portion expressing the hull-volume saved by our system.

The hull is sub-divided by several water-tight bulkheads, the necessity for which has been clearly demonstrated by various accidents to submarines. It is possible that "C 11" would not have sunk so quickly if she had been thus divided.

The great reserve of buoyancy at surface trim is obtained by the arrangement of the superstructure. This also forms the deck, and is attached to the hull proper by strong beams which reinforce the upper works of the hull and enable it to withstand the heavy pressure experienced when submerged.

Sketch No. 2 illustrates this special construction of the boat.

ABCD is the hull proper.

AMNC the water-tight superstructure.

ABC one of the strong beams referred to.

OOO bracing connecting the strong beams with the deck beams of the superstructure.

XY the water-line.

Along the sides of the superstructure and above the water-line XY several valves are fitted, which are opened when the boat is prepared for diving.

To submerge the boat, water is admitted to the water ballast tanks WW by opening the Kingston valves KK. When she begins to sink, and during the process of sinking, the superstructure is automatically filled through the valves VV. It must be noticed that the water in the superstructure is not water ballast proper, as the sinking of the boat is not affected by it.

When the boat is to be brought to the surface, water is expelled from the tanks WW either by an electrically driven pump or compressed air, and as the boat rises the water flows automatically out of the superstructure through the valves VV. When the tanks WW are empty the water line is again at XY and the superstructure is empty.

After the surface is reached, the valves VV are shut, and the superstructure, being thus made water-tight, gives the boat the large reserve of buoyancy which assures to her the same sea-going qualities as an ordinary torpedo boat. This arrangement is entirely different from that of all other submarines.

The longitudinal section shows how the boat is sub-divided, and also the device of keeping all the water ballast in the midship compartment,

which is advantageous for facility of trimming the vessel as well as making her handy on her helm.

The ballast tanks as constructed by the Fiat Co. are of heavy plating, to adapt them for being emptied by pumps when at a great depth in the event of there being little or no compressed air left. Nearly all other submarines have their tanks built of lighter scantling, so that if they are at a great depth and short of compressed air, the emptying of the tanks is accompanied by a risk of the plates collapsing under the external pressure.

The Fiat San Giorgio submarines of Laurenti's type have been adopted by the Italian, Swedish, Danish, and United States Admiralties, which have all been highly satisfied with the good and trustworthy qualities possessed by these boats. The most important test of their excellent sea-going character has been afforded by the recent voyage of the submarine "Hvalen." The "Hvalen" has a small internal cubic capacity—only 185 tons displacement in surface trim—and her principal dimensions are:

Length 42.48 m. = 139.4 feet.

Beam 4.28 m. = 14.0 "

Draught 2.50 m. = 8.2 "

She is propelled by three sets of Fiat petrol marine engines, each driving one screw.

The "Hvalen" left Spezia on July 30th, proceeded direct to Carthage, coasting round the Gulf of Lyons to avoid bad weather, and arrived on August 2nd, having covered a distance of 790 nautical miles without a stop. This run was at that time the longest ever made by any submarine of whatever tonnage, and is still the record distance-run for any submarine of the "Hvalen's" displacement. From Carthage the "Hvalen" went to Gibraltar, from Gibraltar to Lisbon, from Lisbon to Oporto, from Oporto to Vigo, from Vigo to Ferrol, from Ferrol to Brest, from Brest to Portsmouth, from Portsmouth to Ymuiden, from Ymuiden to Kiel, and from Kiel to Stockholm.

The vessel was absolutely without escort. She met with some very rough weather, especially on the coast of Portugal and in the Baltic, but always behaved splendidly and kept up her cruising speed, making such good weather of it that her crew were always able to cook their food on deck.

Captain Magnusson and Lieutenant Von Heidenstam, of the Swedish Navy, were the two officers on board, and great credit must be given to them and their petty officers and sailors for the remarkable performance, as well as to the Fiat San Giorgio Co. and Constructor Laurenti.

NEW CHINESE GUNBOAT "YUNG FUNG"

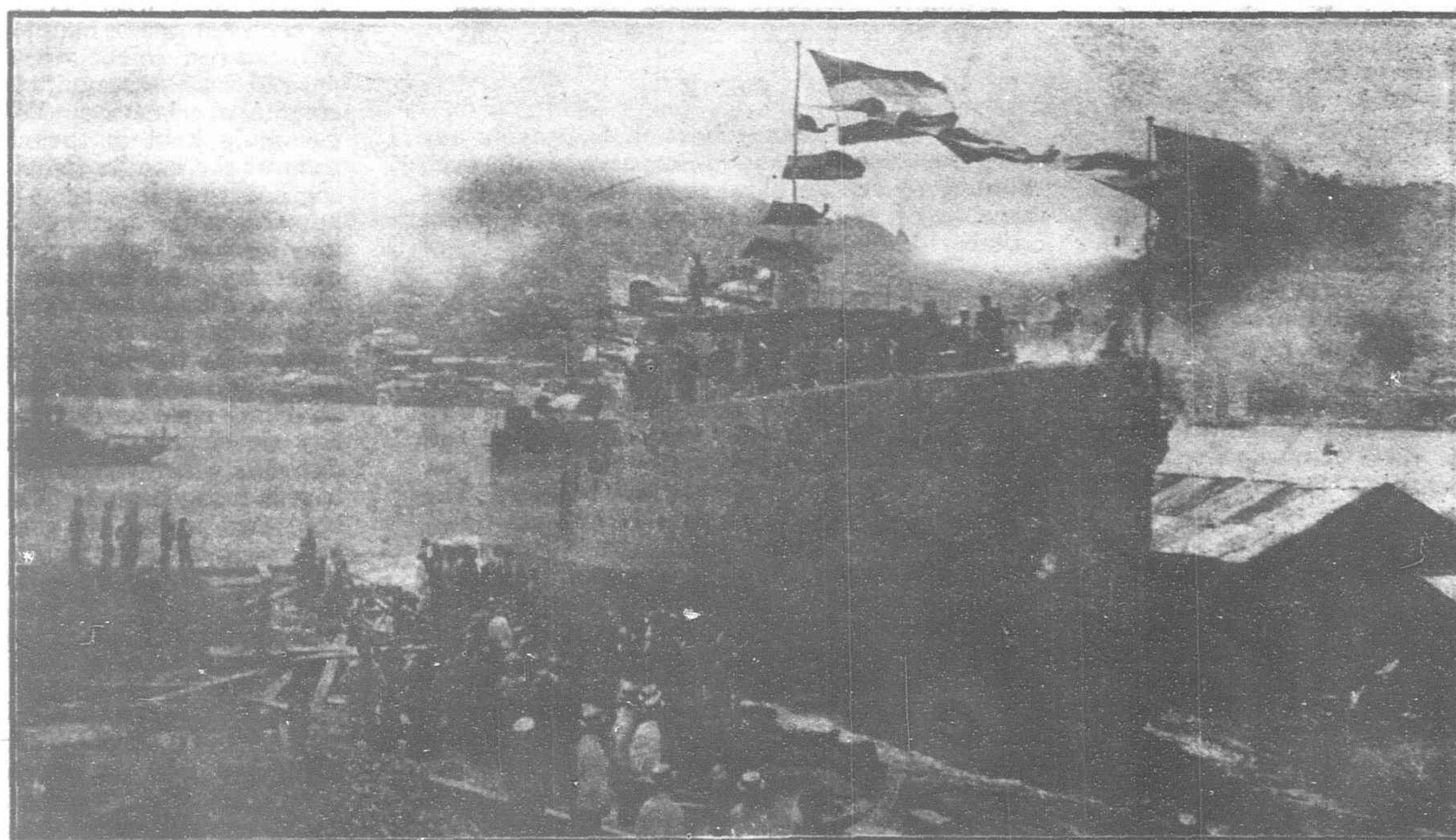
BUILT BY THE MITSU BISHI DOCKYARD AND
ENGINE WORKS.

The first warship built at the Mitsu Bishi Dockyard and Engine Works, Nagasaki, for a foreign country was successfully launched on the 5th of July. The vessel is a gunboat, designed for river service, ordered by the Chinese Imperial Government. The keel of the Yung Fung was laid down on August 15th, 1911, and the contract calls for her completion within twelve months. Her dimensions are as follow:—

Length, B. P. P.	205'-3"
Breadth, extreme	29'-6"
Depth, moulded	14'-9"
Draught, excluding Keel .	8'-0"
Displacement	830 tons
Indicated Horse Power . .	1,350 H. P.
Type of Engine	2—Vertical Triple Expansion Engines.
Type of Boiler	2—Steel Cylindrical Boilers.
Propeller	Twin Screws.
Wireless Telegraph . . .	One complete set of the "Teishin-Sho" Type (Singing Spark System.)
Keel Laid	15th August, 1911.
Launching	5th July, 1912.
Delivery	15th August, 1912.
Speed on Trial Trip . . .	13½ knots.

The crane that is being built to be planted at the Mitsu Bishi shipbuilding Engine Works, Nagasaki, will, it is said, to be the largest in the world. It has a length of 800 ft. breadth of 116, and a height of 130. It will be finished next month.

It is reported from Tokio that three battle-cruisers which are now being built for the Imperial Navy at Nagasaki, Yokohama, and Kobe are to be sister-ships of the Kongo, which was launched in England on the 18th instant. The principal armament of these vessels, which consists of eight 14-inch guns, or 13.5 in calibre, together with 16 6in. guns will probably be constructed at the Muroran Steel Foundry. The Kongo is an armoured cruiser, laid down in 1911. The names of her sister ships will be Hiyei, Kirishima and Haruna. All four vessels are to be 27,000 tons displacement, and will have turbine engines of 64,000 h.p.

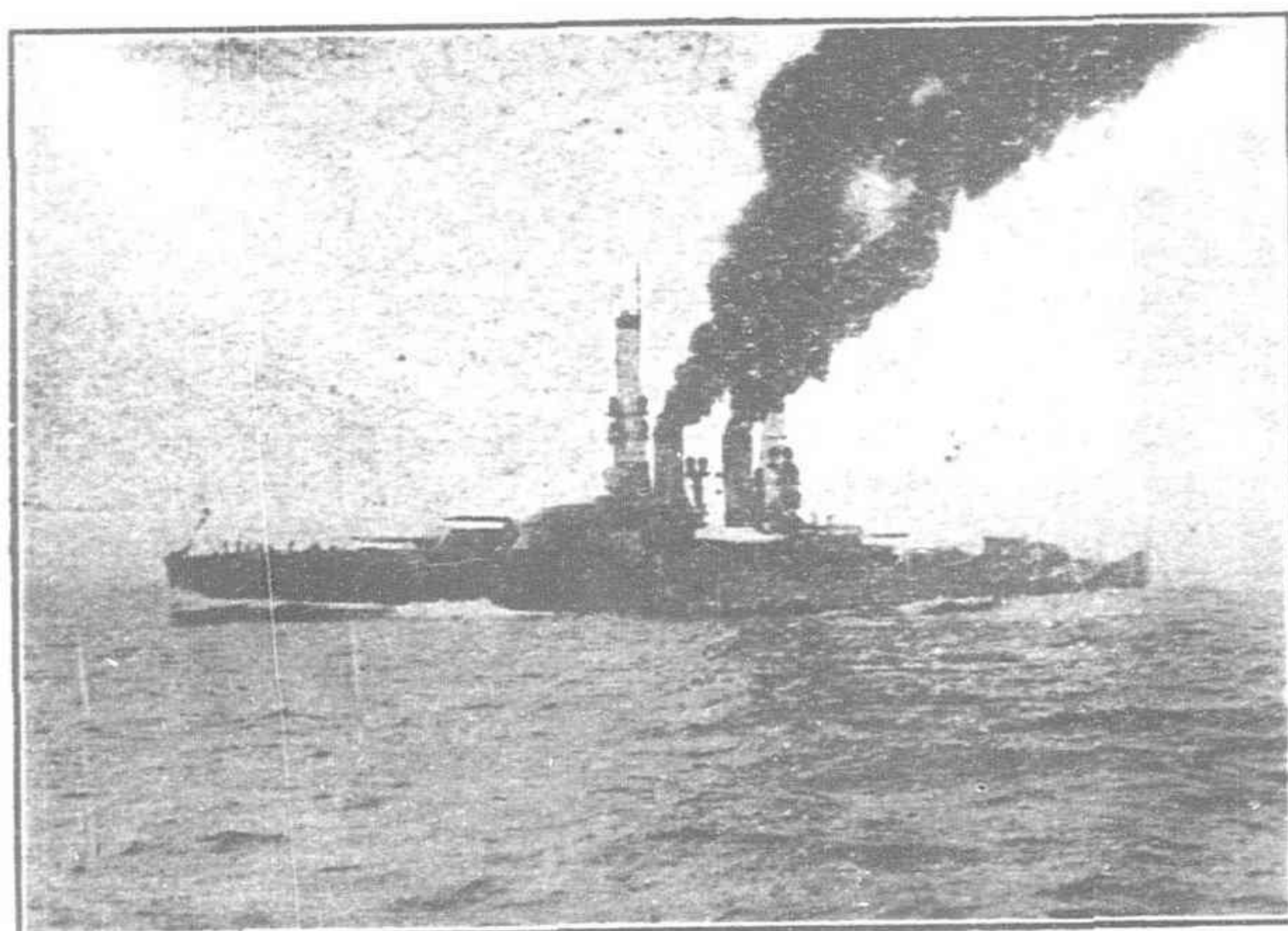


CHINESE GUNBOAT "YUEN FUNG," LAUNCHED AT THE MITSU BISHI DOCKYARD & SHIPBUILDING WORKS AT NAGASAKI

FINAL ACCEPTANCE TRIALS OF THE U.S.S. "UTAH" AND "FLORIDA."

These latest dreadnaughts of the U.S. Navy cost in the neighbourhood of \$10,000,000 apiece. Vessels for the Navy are put through a builders' trial and then through a Government trial before they are accepted. These trials are made under what might be called "special conditions." The course is selected, the crew is selected and the officers are selected. After the vessels has been turned over to the Government and gone into service, which may be a year or more later,—when she has her own crew, regular fuel, her own officers and is in every sense a "regular vessel," she is put through another Navy trial, and in that trial the conditions are those of actual service. There is no opportunity for any selection or specialization in connection with course, officers, crew or fuel.

The "Utah" and "Florida" were designed for 20.75 knots. The "Utah" during her standardization trial over measured mile ran 21.92, the "Florida" 22.54. During the four hour trials the "Florida" showed 22.07 average speed and the "Utah" 21.042.



U. S. S. "FLORIDA"

What does this mean to the Nation and to the crews of these ships? It means that the vessel is so much more able to get into action or to get out it. She is able to catch a vessel in case of war whom she desires to overtake or is better able to get away from a vessel that desires to overtake her, thus enhancing the safety of something like one thousand lives on board each boat.

Speed is one of the controlling elements of defence. These vessels have speeds far beyond those for which they were designed. It is a factor which may mean the saving of the whole ship or the winning of a victory with all its consequences upon the Nation's honour and the Nation's commerce. It all comes back to the careful engineering that was done in designing the vessel and certainly no one detail was of as great importance as the forced draft system whereby the air is supplied, without which the ship could not go. It is a well known fact that all fuels in order to burn require to be supplied with air, as the heat of a fire is produced by the chemical action which takes place when the combustible unites with oxygen, which gas forms one-fifth of the earth's atmosphere. In these ships the necessary air is forced under the boiler fires by means of "Sirocco" Blowers, designed and manufactured by the American Blower Company of Detroit, Michigan.

With the finest turbines, best boiler power, best fuel and best stoking the vessels could not have attained the speed they did if there had not been air enough. The Navy Department say frankly that they had an abundance of air and that everything was perfectly satisfactory.

In short, this superior forced draft system renders these vessels with all that they are as representatives of the Nation's honour, safety and protection in the time of need, far better able to do their work.

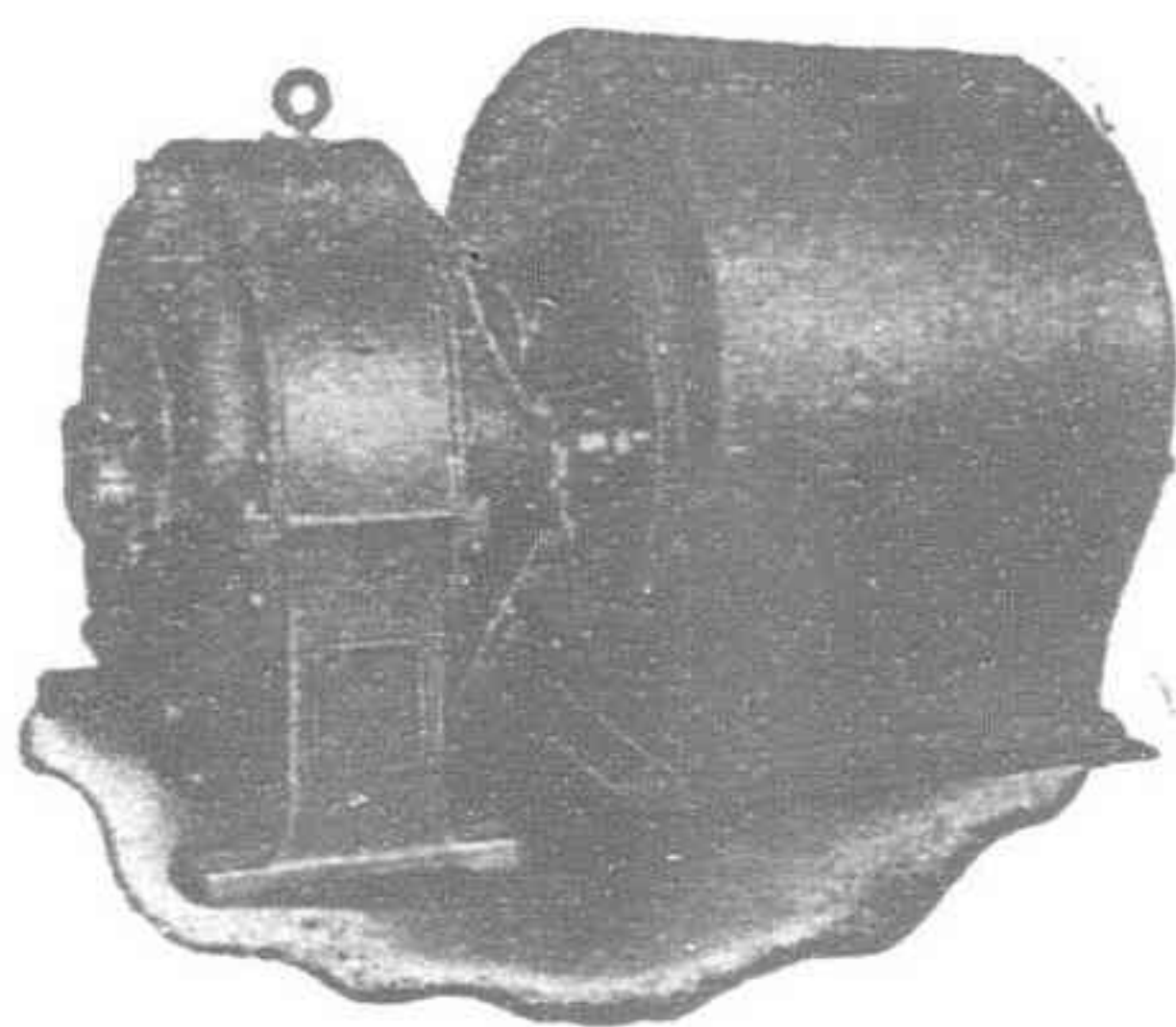


FIG. 1

Twelve blowers with direct connected motors like the one shown in Fig. 1 are installed on each of these boats.

The wheel of each blower is only 33" in diameter, but owing to its great efficiency is capable of delivering 28,500 cubic feet of air per minute.

With all blowers in operation at the same time the amount of air delivered to the boiler fires is 342,000 cubic feet per minute, or 768 tons of air per hour.

The collective capacity of the 12 fans used on each battleship can, however, be expressed more comprehensively in terms of space than by weight, so that a clearer realization can be obtained when it is considered that 768 tons of air per hour means slightly more than would be contained in a tank of 200' long, 200' wide and 510' high.

Under average conditions about 18 pounds or 240 cubic feet of air are required to provide enough oxygen for the combustion of one pound of coal so that the full set of 12 Sirocco fans will furnish sufficient air to burn 43 tons of coal per hour.

Every inch of space in the machinery rooms of a man-of-war is valuable so that these important factors in the ship's equipment are crowded into the smallest possible compass, making it impossible to secure good photographs of the installations. The one from which Fig. 2 was made was taken on the "Florida" and serves to show clearly the extremely small comparative size of the blowers which have the tremendous capacity noted above. It is, in fact, only since the invention of the "Sirocco"

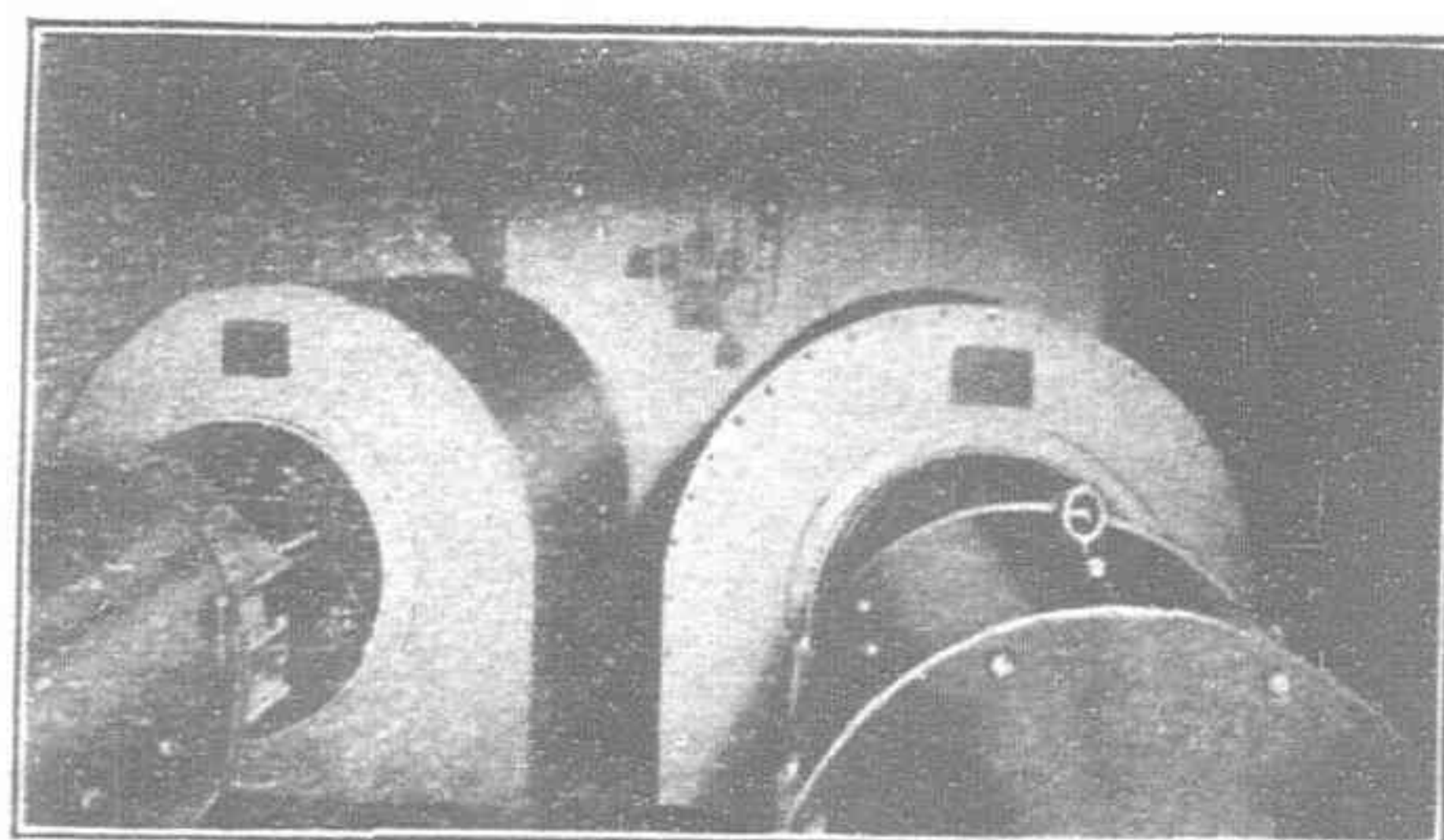


FIG. 2

Blower that it has been possible to provide any such immense air handling capacity within such limited space, as blowers of the older types capable of the same service are much more cumbersome machines.

PALMETTO PACKING FOR THE "THUNDERER."

It is interesting to note in connection with the completion of the very successful full power trial of the Battleship "Thunderer" on the 5th of March last, that her builders, The Thames Iron Works, Shipbuilding and Engineering Co., Ltd., purchased "Palmetto" packing for use aboard the Super-dreadnaught at her trial, and the high record made on the trials would indicate that the judgment of her builders was not at fault, even in so small an item as the selection of the rod packing.

Steam engineering of the present day development, with its high pressure and super-heated steam, requires a rod packing far different from those that gave satisfaction in the past. Super-heated steam makes impossible the using of any packing made wholly or in part of vegetable substance, such as rubber, cotton duck, etc., and even asbestos in its ordinary state quickly

hardens when submitted to great heat under pressure.

The reason "Palmetto" packing is selected to work under extreme conditions is because it contains no vegetable substance, and by a special treatment of each single strand with a graphite grease lubricant before plaiting the tendency to harden is removed. The lubricant serving the double purpose of preserving the soft pliable nature of the packing, and so lubricating the rod as to reduce friction load on the engine and enhance the life of the packing.

G. E. HEATING AND COOKING DEVICES.

The Heating and Cooking Devices developed by the General Electric Company are efficient, thoroughly practicable and convenient. Efficiency and practicability are insured by the use of "Calorite" for the heating elements. Calorite is recognized as the most efficient substance ever produced for converting electricity into heat. It is the result of extensive and costly research work in the Company's laboratories, and is used exclusively in the Company's devices. These devices are adapted to both household and industrial purposes, and can be used to excellent advantage in homes, hotels, and hospitals; in the offices of physicians and dentists; in book binderies, laundries, tailor shops, etc. Their use insures cleanliness and the lightening of labor, and they are applicable in all places having suitable electric wiring, in many cases it being necessary only to connect the devices to the ordinary lighting sockets. The home devices particularly are attractive in appearance, occupy no more space than ordinary cooking utensils, are much more convenient and are being widely used.

In addition to the superior cleanliness of these devices they are better than all methods of heating by flame in that they are entirely free from the disagreeable odors given off by gas, gasoline, oil or coal stoves. Also, they are perfectly safe being absolutely free from dangers such as gas asphyxiation, explosions, and all fire risk.

The G. E. Flatirons are designed to meet all the requirements of domestic and industrial work. They are available in various sizes, varying from 3 to 24 pounds in weight: 3-lb. irons for light pressing of all kinds such as shirt waists, baby's clothes, collars, ties, and ribbons and delicate and valuable laces and embroidery; 4½ and 6-lb. diamond face and morocco faced polishing irons; 5, 6, and 8-lb. irons for all kinds of regular ironing; and 12, 15, 18 and 24-lb. pressing irons for heavy laundry work and tailors' work. The irons may be obtained with detachable plain plugs or switch plugs, with permanently attached cord, or with automatic handle switches. The latter afford a convenient method of maintaining the desired heat without any danger due to accidental overheating. While ironing the handle switch is held in the closed position, but as soon as the handle switch is released the metal cap covering it springs off to one side, thus automatically opening the switch. Ironing may be done, however, with the switch open if necessary. All irons are finished in nickel and present a handsome appearance.

In order to retain all the advantages of electrically heating flat irons and at the same time to do away with the necessity of using an attaching cord on the iron itself, the Company has developed a *heating stand for electric flatirons* which consumes current only when the iron is being heated. The stand is designed to hold two irons. It consists of a shoot-iron base supported on four composition feet, and having in the center an inclined plane of heavy asbestos board. A composition block containing flexible phosphor bronze contacts is located at the foot of the board. The electrical connection to the stand is made by means of the ordinary attaching cord and plug. The iron to be heated is placed on the inclined asbestos board on which it slides down by gravity until the terminals on the iron automatically engage the phosphor bronze contacts on the stand and completes the circuit. The iron heats rapidly as the asbestos board prevents radiation from the flat surface of the

iron. The removal of the iron after heating instantly interrupts the circuit, thus preventing current consumption except while the iron is being heated. Irons not in service can be placed on the shelf on either side of the inclined plane.

G. E. Chafing Dishes are available in a variety of styles. They are designed for kitchen cooking as well as for dining room or parlor use. They are made of aluminum, of simple and substantial construction, and pleasing design. They are easily kept clean.

The method of construction is the same for all. Each disk consists of an outer and an inner shell spun together at the upper edge. Both parts are seamless, the outer is made of polished aluminum, and the inner or water pan is made of copper heavily tinned on the inside. The food pan or blazer is made of polished sheet aluminum, and is provided with a long and convenient side handle. The water pan is provided with two side handles with ebonized wooden grips. Aluminum cooking utensils are becoming very popular, and there are hundreds of cooking recipes that can be successfully carried out with an electric chafing dish. They are a great convenience not only in the home, but also in restaurants, cafes, and clubs, and on yachts, steamships and dining cars.

G. E. Coffee Percolators are available in 1½, 2½, 3 and 4 pint sizes, with either nickel or copper finish. Silver finish can be furnished on special order. These devices enable the making of a delicious and healthful beverage, extracting only the delicate aroma and nourishing elements in the coffee bean, and discarding the tannin and other harmful properties. They are designed to make coffee quickly, the time required varying from 45 seconds to about 2 minutes for starting percolation, according to the size of the percolator, and a total of ten minutes for completing the process, begun with cold water drawn from the faucet. These excellent results are obtained by the use of a new style pump, and the better heat distribution effected by the new flat disk heating element. The pump is so designed that only a small amount of water is heated at one time in the pocket in the base of the pump, the steam from this forcing out the water through the tube above it, thus obviating the necessity of heating a large amount of water before percolation commences. A handsome line of 3-pint samovars is also available.

G. E. Culinary Utensils comprise a line of devices carefully designed to meet the requirements of different methods of cooking.

G. E. Portable Disk Stoves are of general utility for cooking food of all kinds in ordinary utensils, and are available in sizes of 3½, 4, 6, 8 and 10 inches disk diameter. They are designed for operation from ordinary lighting circuits and while effective and convenient in the kitchen are indispensable in hospital wards, home sick rooms and nurseries, laboratories and other places where smoke, flame and gas is objectionable. The 3½ and 4 inch stoves give a heat of one intensity. The former is suitable for use in laboratories or in dentists offices for heating small quantities of liquids, the 4 inches stove is adapted to general use. The 6, 8 and 10 inch stoves have three-heat switches for providing three heats of different intensities. These stoves heat up quickly, requiring about 8 to 10 minutes to attain full heat, and will remain hot for 10 or 15 minutes after turning off the current. Their design is such that they will not become injured by overheating in case they are allowed to run without anything on them to take away the heat. The Twin Disk Hot Plate is designed to do the work of the usual gas plate. It consists of two 8-inch disk stoves suitably mounted and arranged for operation independently. Until the production of Calorite for use in the heating elements of electric stoves, etc., it was impossible to dissipate the required amount of heat within the area of an 8-inch disk. These Calorite stoves are capable of operating continuously at a red heat without injury. In considering the use of disk stoves it should be borne in mind that on account of their wide range of adaptability to any utensil they are

not so efficient for any one purpose as a self-heating device, such as a broiler or a grid designed for that particular purpose.

G. E. Broilers are arranged to provide three intensities of heat. Ten minutes is needed to bring the broiler to full heat, and a steak can be properly broiled in about seventeen minutes. The absence of gas odors, a hot fire and the dirt accompanying other methods of broiling, commends this device to the favor of the public.

G. E. Grids consists of a smoothly polished flat top aluminum casting 9 by 12 inches supported on four malleable iron legs 6 inches long. To bake griddle cakes properly an evenly distributed heat is necessary. This is best accomplished by the use of an aluminum plate. The grid is arranged to provide three heats, but the medium or low heat should not be used for a comparatively short interval of service, as they are better adapted to continuous baking or toasting. About seven minutes heating with full current is all the time required to put the grid in proper condition for baking griddle cakes.

G. E. Radiant Wire Toasters of the domestic type are four inches by seven inches base and seven inches high. They are arranged to toast two slices of bread simultaneously, the time required being about three minutes. The *G. E. Toaster* embodies a number of excellent features: Large spaces for bread permitting the toasting of any size of slice from that of home made bread to a cheese wafer, with equally good results; the absence of the inconvenient cover required in horizontal design to overcome the drawback of heated air currents; the use of radiant heat which alone can produce perfectly toasted bread, crisp and golden throughout. The restaurant type of radiant wire toaster is designed to toast six slices of bread simultaneously.

G. E. Combination Cookers are available in 2, 4, and 6 quart sizes, arranged for three heats, and 2, 2½ and 3-pint, and 2 and 4 quart tea kettles in two and three heats. These are made of aluminum with highly polished exterior surfaces, and are of great durability.

G. E. Kettles have been tested for 1,000 hours operating at full heat without water, and have showed no signs of deterioration. Kettles can be obtained in brass, copper or nickel finish.

G. E. Frying Pans are available in 5, 7, and 10-inch sizes. They are very convenient in light housekeeping and have no equal in preparing early breakfast. The pan is made of polished steel and is mounted on an aluminum body, thus combining the very necessary characteristics of the ordinary iron utensil with light weight and sufficient strength to withstand long usage. The 5-inch pan is arranged for one heat, the 7-inch for two heats and the 10-inch for three heats.

G. E. Water Heaters are available in various sizes. The one-half pint water heater consists of a white enamel cup mounted on nickel supports. Enamel ware is used for this cup because it can be kept clean easily, and also possesses other sanitary qualities. The addition of a nickel soap tray readily adapts it for use. As a shaving cup. The low current consumption makes it inexpensive and it can be attached to any lighting socket. The pint and quart water heaters are very popular as milk warmers. The cover is made in two parts. There is a removable center, which, when taken away, leaves a hole in which a Hygea milk bottle will readily fit. The standard thin glass milk sterilizer flask may also be used in this manner, by first taking off the cover to allow the large part of the flask to be placed in the heater cup. Only two tablespoonfuls of water need be used. When the heat is on this water is quickly turned to steam, and upon coming in contact with the sides and top of the vessel condenses, falls to the bottom of the cup, and is again evaporated as before. The milk in the bottle becomes thoroughly heated in about one-fifth the time required by the usual hot water method. The water heaters of larger capacity, 2, 4, and 6 quarts, are arranged for three-heats and may be used for cooking vegetables, pot roasts, etc., for a large family. The regular

electric Hot Water Shaving Cup and the electric Corn Popper completes this line of devices. The corn popper has a capacity of about one quart and is fitted with a wire mesh dome cover. A convenient handle and rubber tired wheels add greatly to the service ability of the device. After the heating element has become properly heated, only about three and one-half minutes is required for popping a batch of corn.

G. E. Baking Devices includes various types of ovens and the standard domestic range. Baking ovens require a temperature ranging from 250 to 450 degrees F. depending upon the nature of the work to be done.

G. E. Ovens are arranged to provide three heats, the different intensities being readily obtained by means of a three heat switch? This accurate heat control prevents the annoyances due to varying and uneven heat and enables the production of a superior article of cooked food. Furthermore, if a process is once accurately timed and the intensity of heat noted, it is always practicable to duplicate the process. These ovens are not only suitable for all classes of domestic baking, but are also useful for baking processes in the industrial arts and in laboratories.

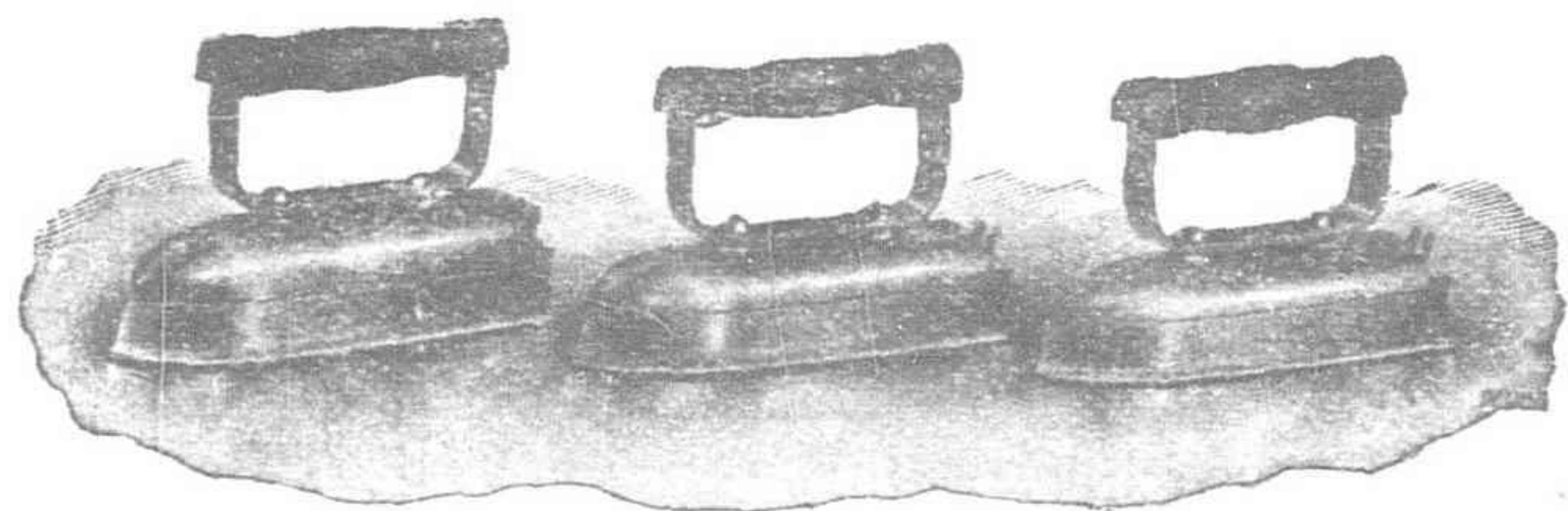
The *G. E. Combination Electric Oven and Broiler* consists of a substantial extra well heat insulated oven in which the top heating element may be exposed, and so arranged that by inserting a broiler attachment the oven may be used as a radiant type broiler. This permits either roasting or broiling with the same device. The heat of the oven is controlled by means of a three-heat switch; the broiler is arranged to give one heat only by the operation of an off-and-on switch.

The *G. E. Domestic Range* is developed along the lines of the usual gas range and is intended to conform to the usual methods of cooking with ordinary utensils. It is equipped with extra rapid disk stoves, requires no special utensils, has an enlarged oven, and an overhead horizontal radiant broiler. The three disk stoves on the top plate are used in the same manner as the burners of a gas range except that flat bottom utensils should be used. Printed instructions accompany each range which tell what intensity of heat to use and how long to leave it on to bake or roast the various kinds of meat, bread, cake, pies, etc., thus insuring uniform success. The oven is of ample size to satisfy the demands of a large family. The broiler and oven have independent switches. The space between the stove top and oven makes a convenient plate and food warming closet. The usefulness of the range is increased by the addition of two extra outlets, one for a coffee percolator and the other for a grid controlled by a three-heat switch mounted on the range.

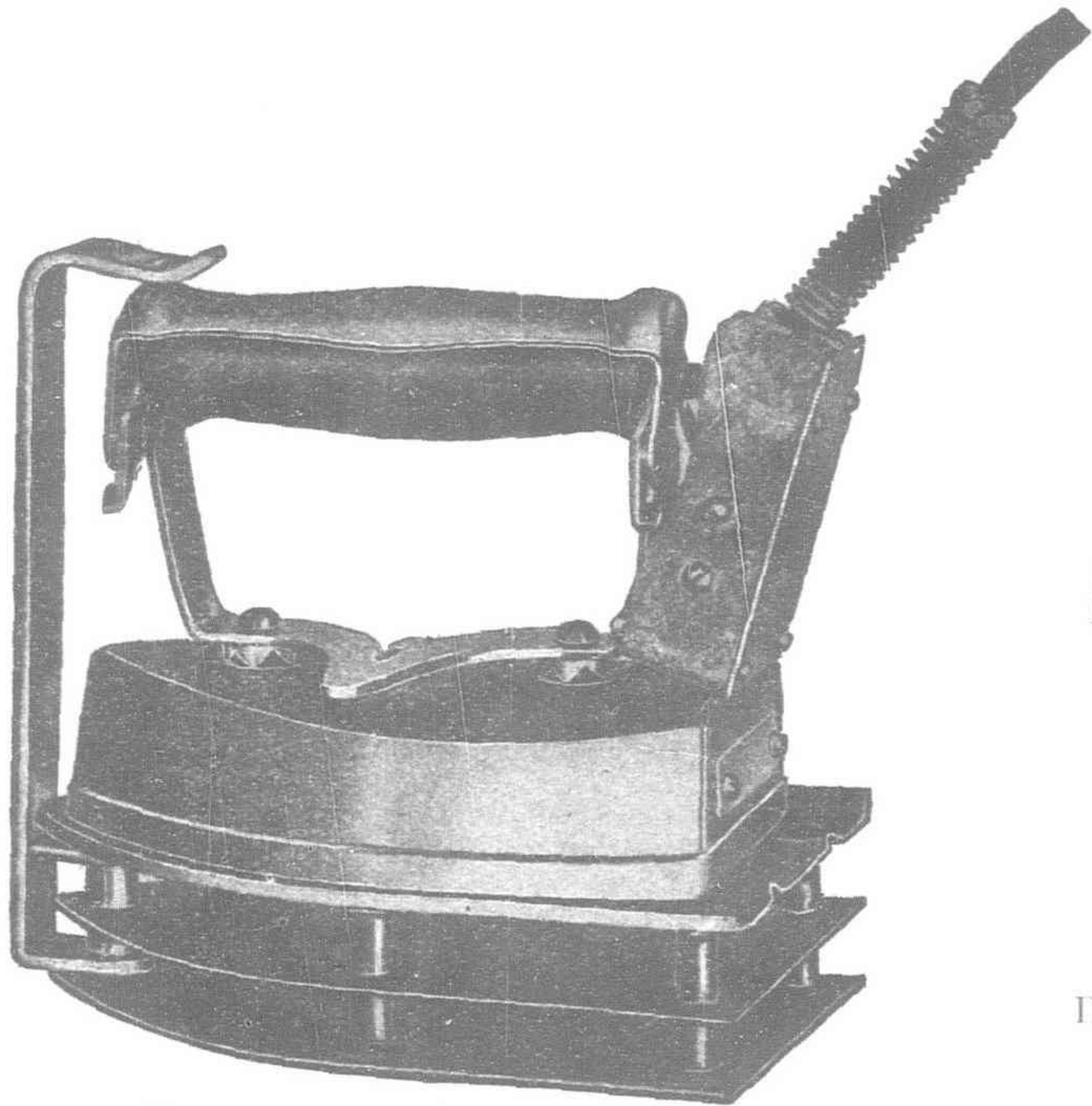
G. E. Heating Devices include several forms of Luminous Radiators and Tubular Air Heaters. The portable luminous radiators have either two or three heating units or glowers. They are efficient, convenient and attractive. The mantle type of luminous radiators uses the same heating units as the portable type, but are designed for permanent installation. They are available in oxidized copper or brushed brass finish. In the tubular air heaters the heating elements are enclosed in metal chimney tubes. These heaters are made in both floor and wall types and consist of four, six or eight tubes. Three heaters are designed to warm large volumes of air at comparatively low temperature and the tubes are arranged so as to have the greatest possible radiating surface. They serve the same purpose as steam or hot water radiators but are much more convenient.

Other heating devices available for industrial purposes are electric glue pots, solder melting pots, stationary soldering irons, portable soldering irons, soldering iron heaters, sealing wax pots, half pint aluminum glue pots, melting pots for lead and tin alloys, celluloid heaters and beer vat dryers.

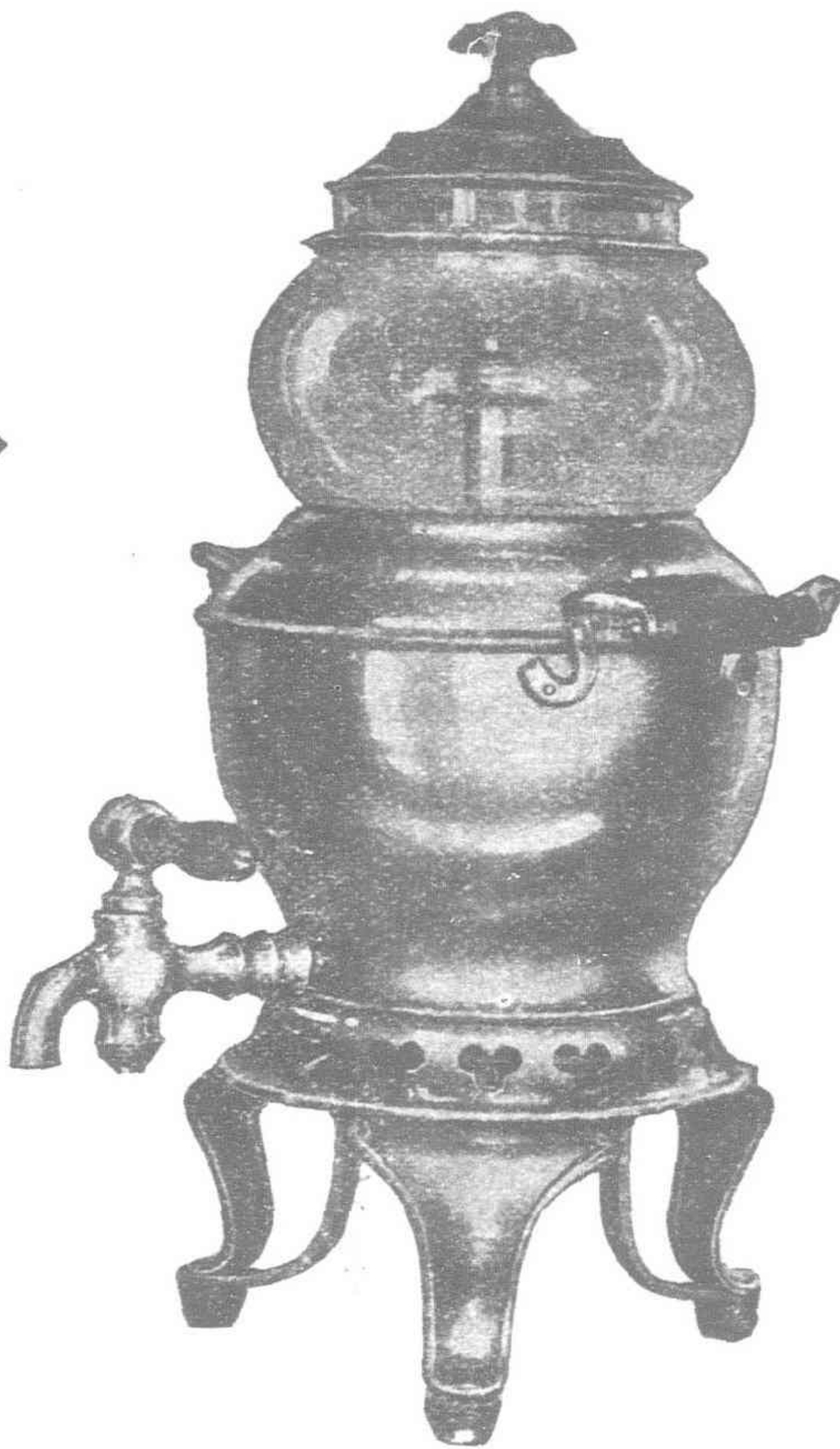
G. E. Glue Pots are quite different from either steam, gas or electrically heated pots of the usual type in that they will operate satisfactorily without a water jacket, thereby



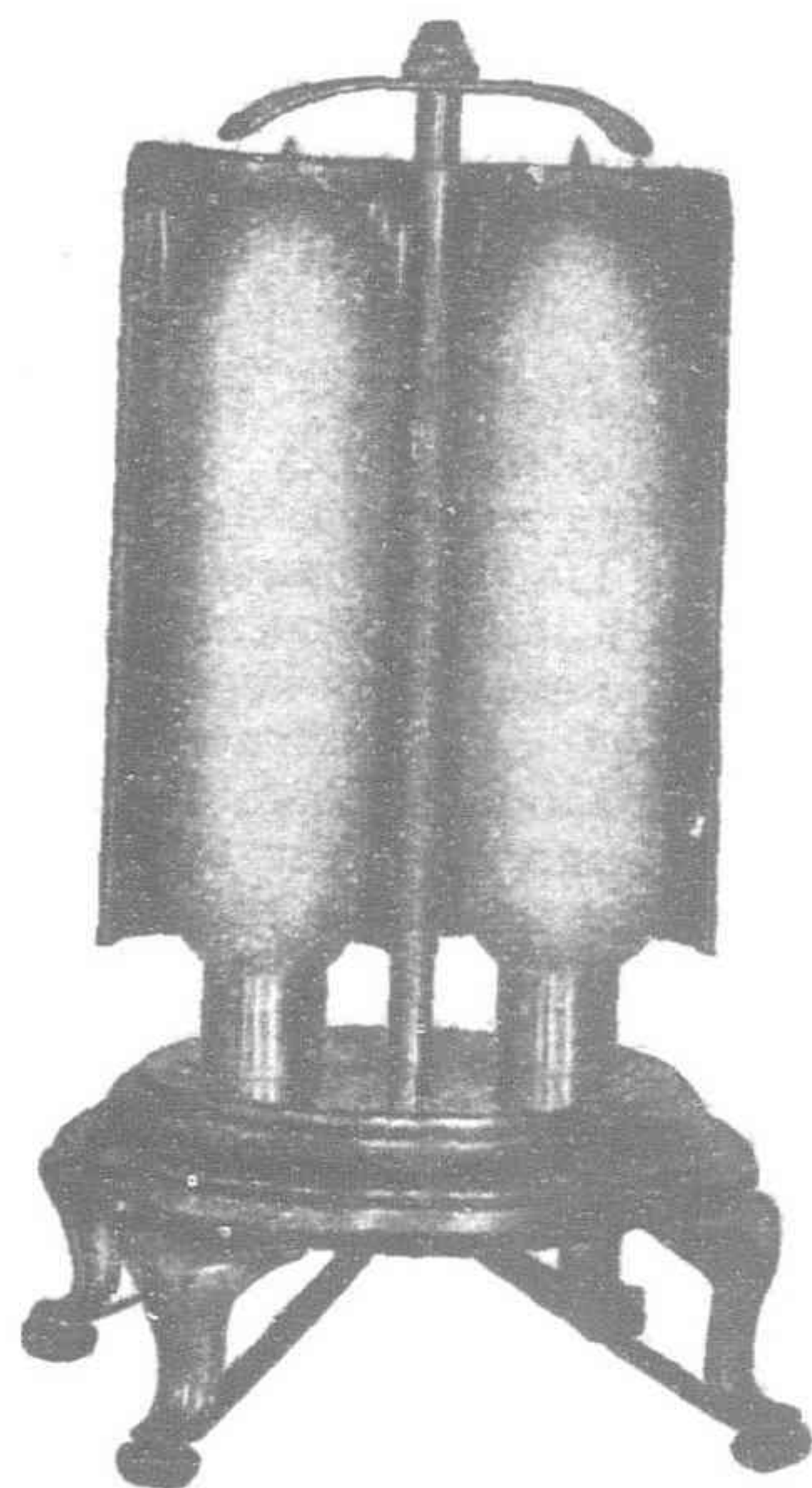
TAILORS' PRESSING IRONS—12, 15, 18 & 24 lb



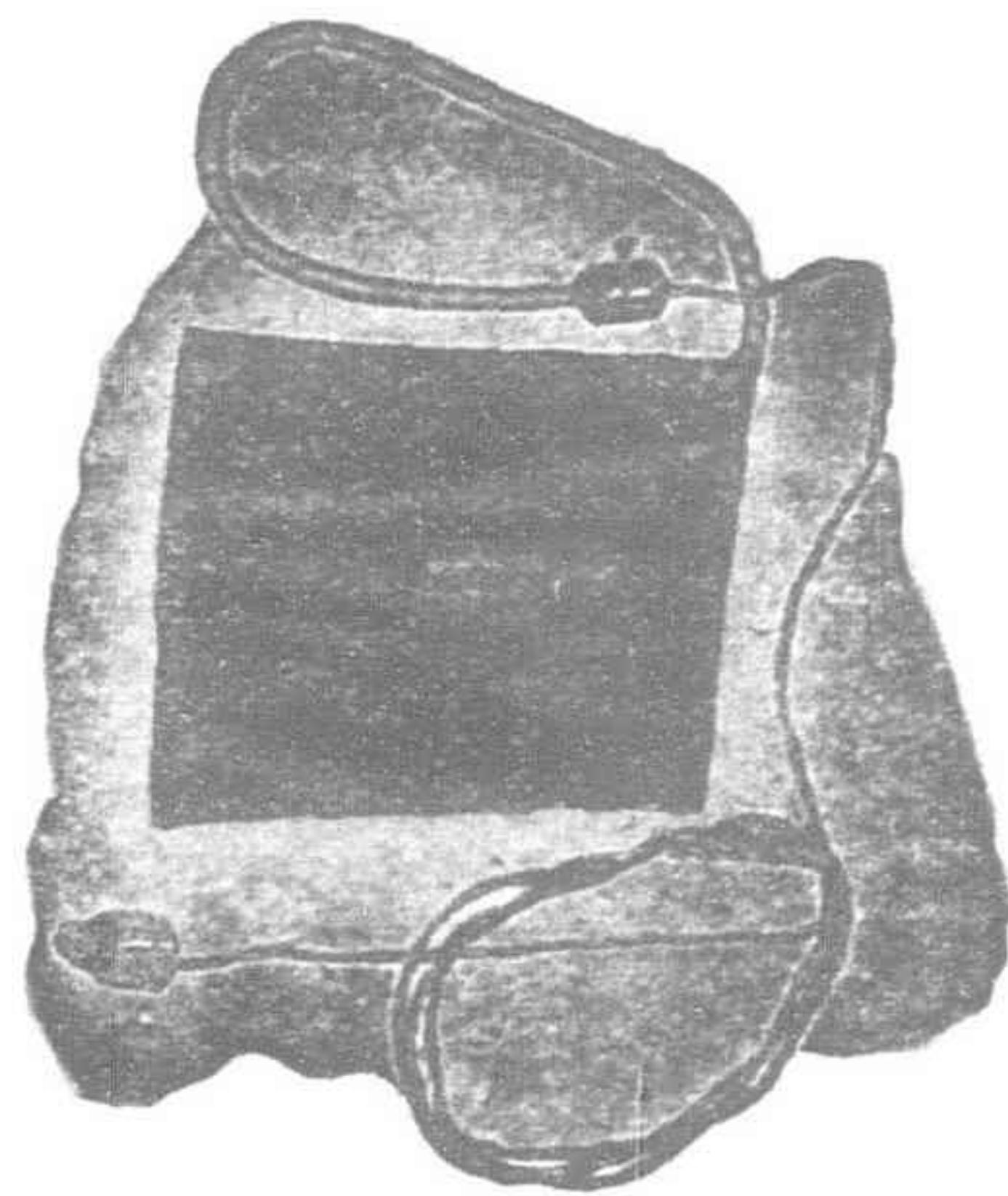
FLATIRON WITH AUTOMATIC HANDLE SWITCH



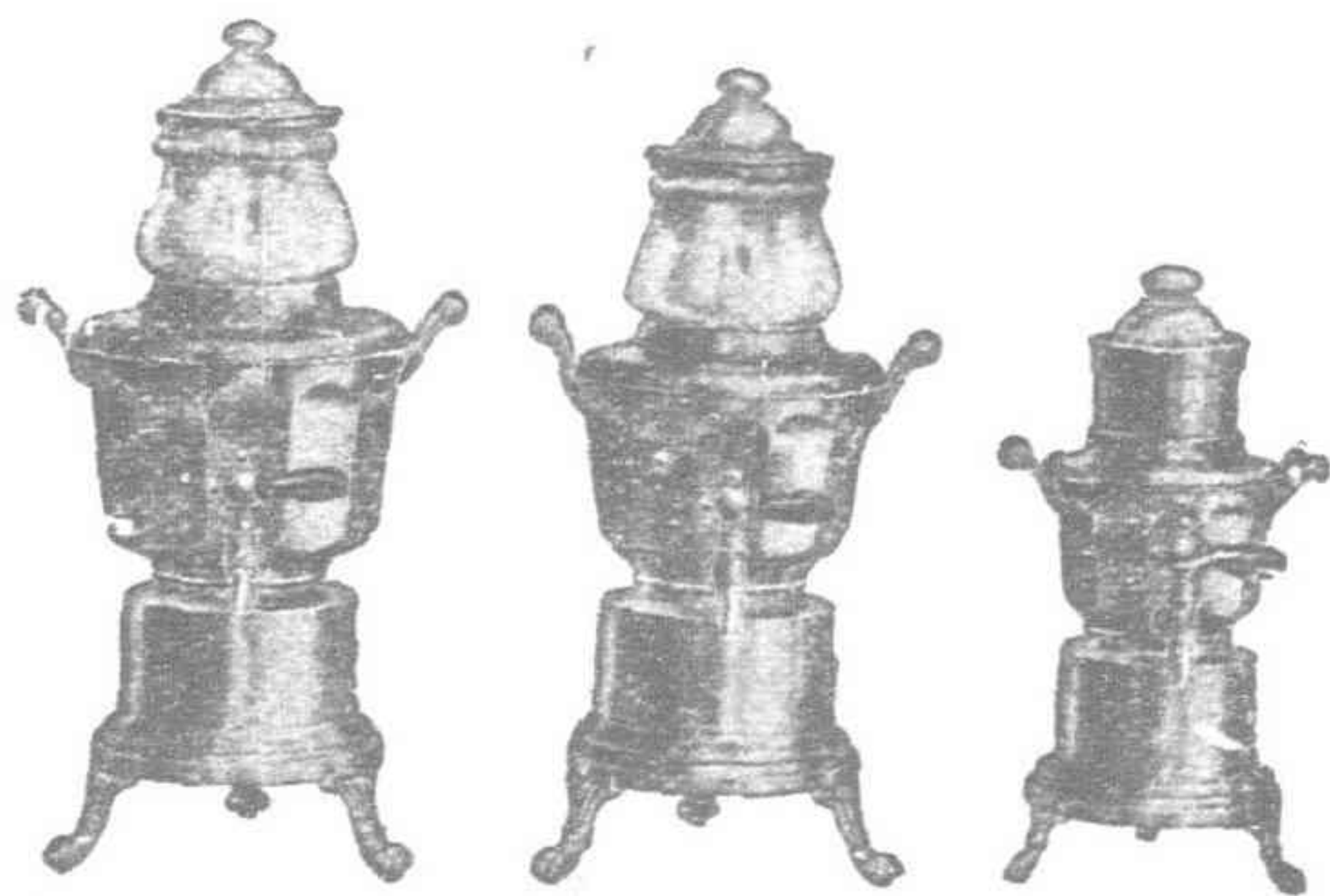
DESIGN S—1,804, 2½ PINT COFFEE PERCOLATOR WITH ENCASED DISK HEATING UNIT



TWIN GLOWER LUMINOUS RADIATOR



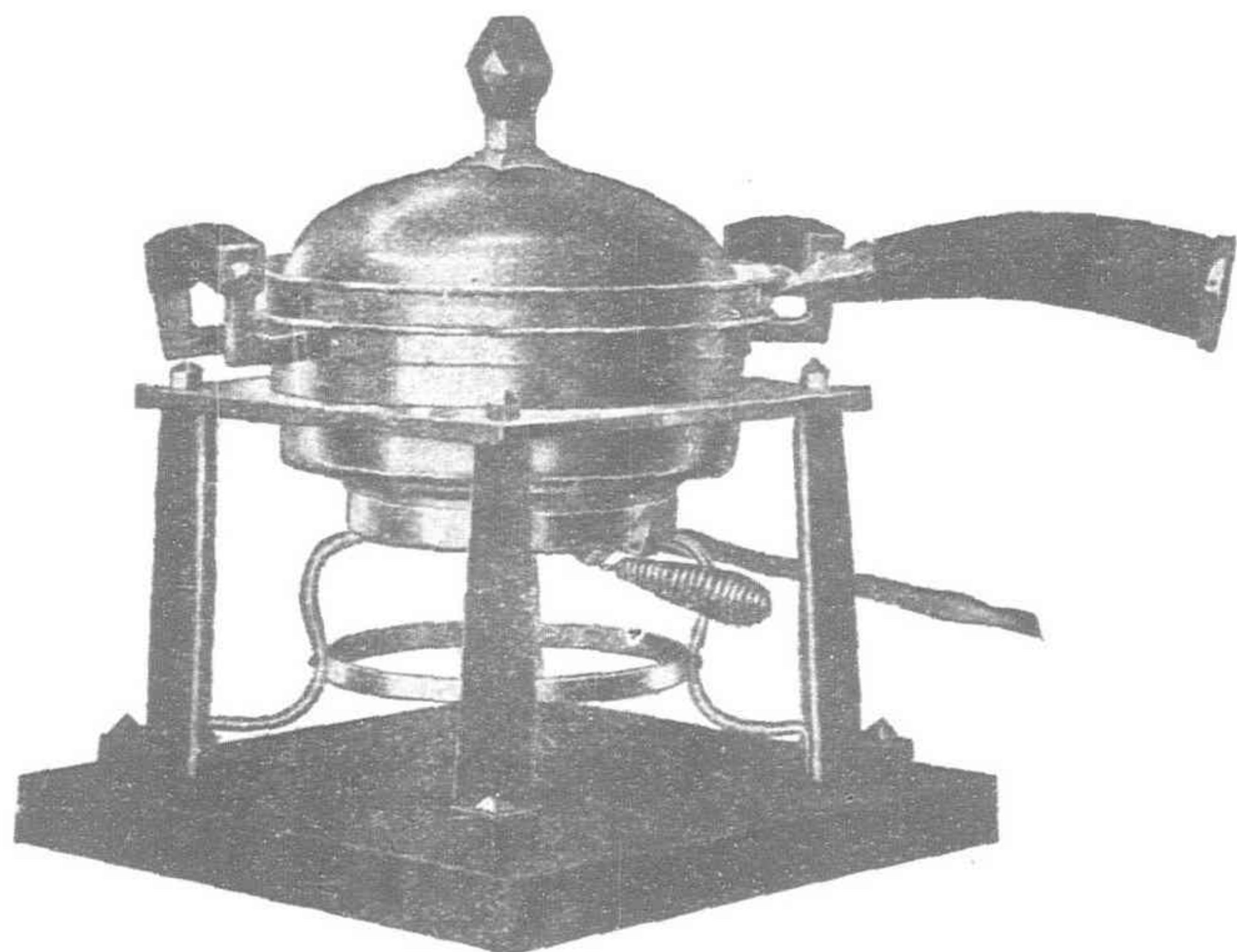
ELECTRIC HEATING PAD WITH REGULATING SWITCH CORD AND ATTACHING PLUG



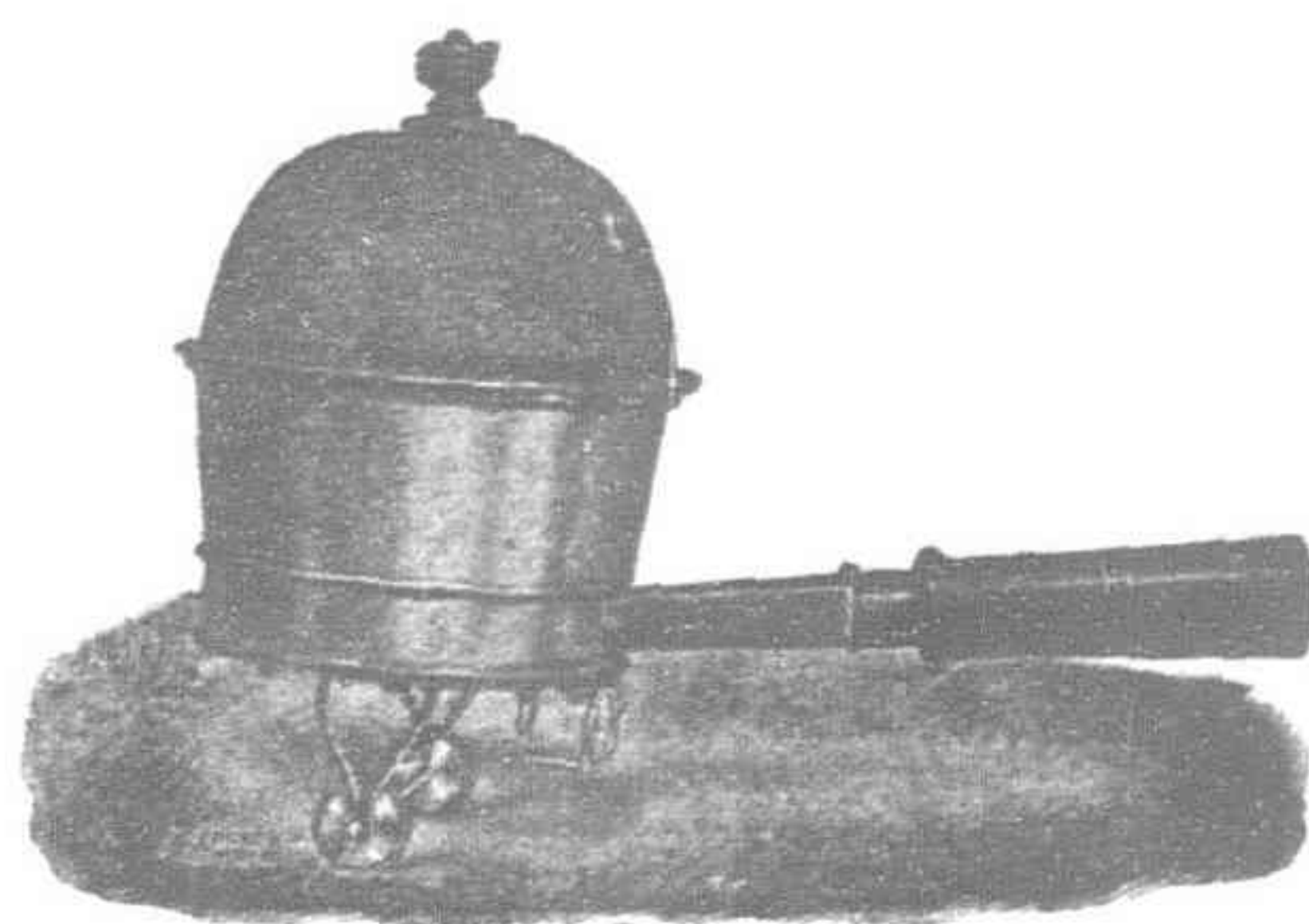
4, 3 and 1½ PINT COFFEE PERCOLATORS, WITH ENCASED FLAT HEATING UNIT



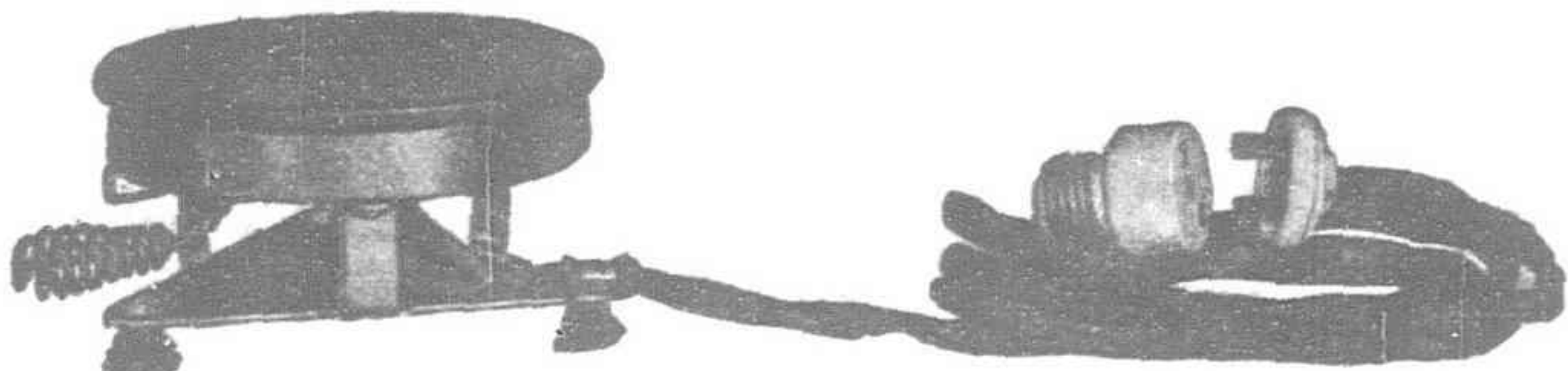
STEEL FRYING PANS—ALUMINUM BODY



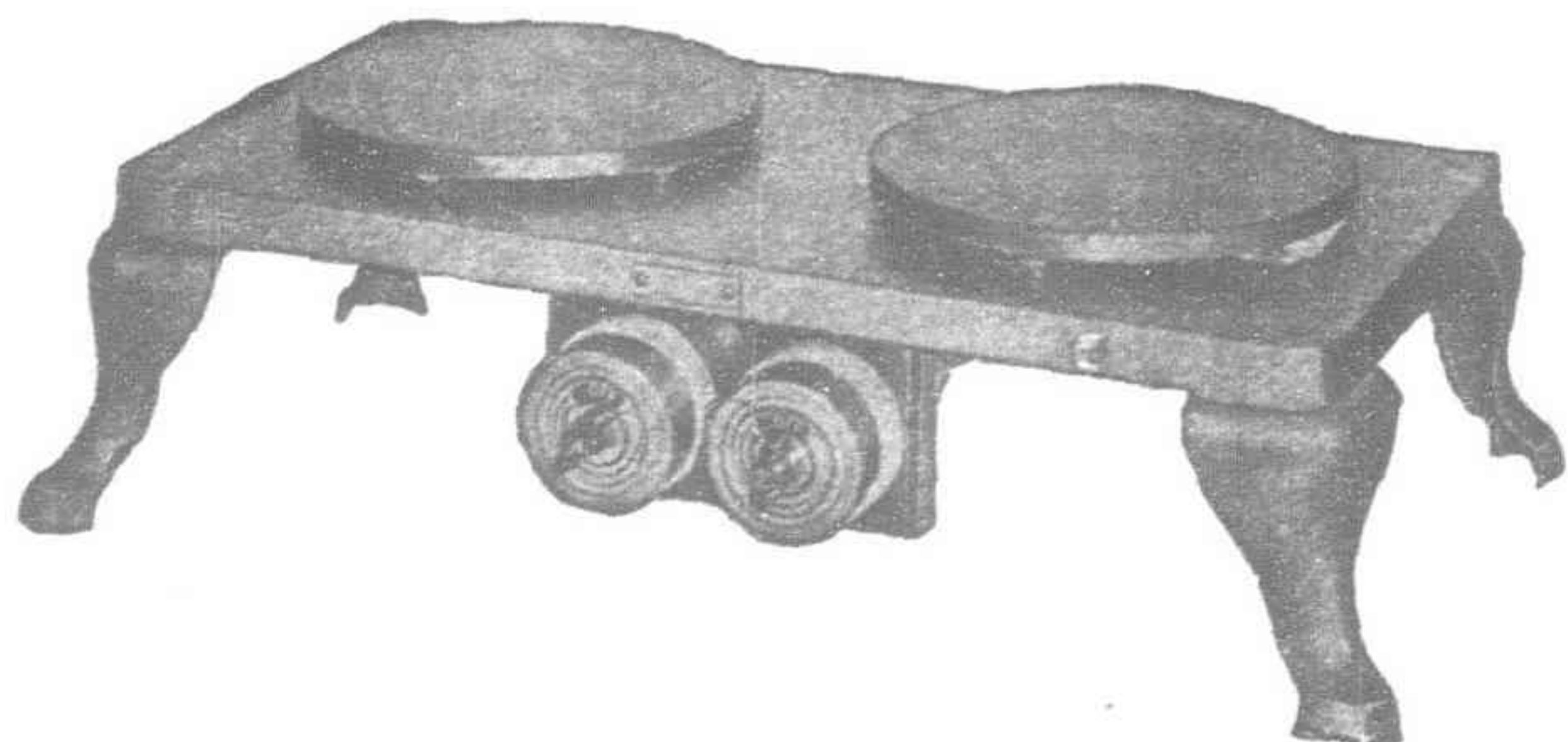
DESIGN S—1,170, CHAFING DISH WITH ENCASED HEATING UNIT



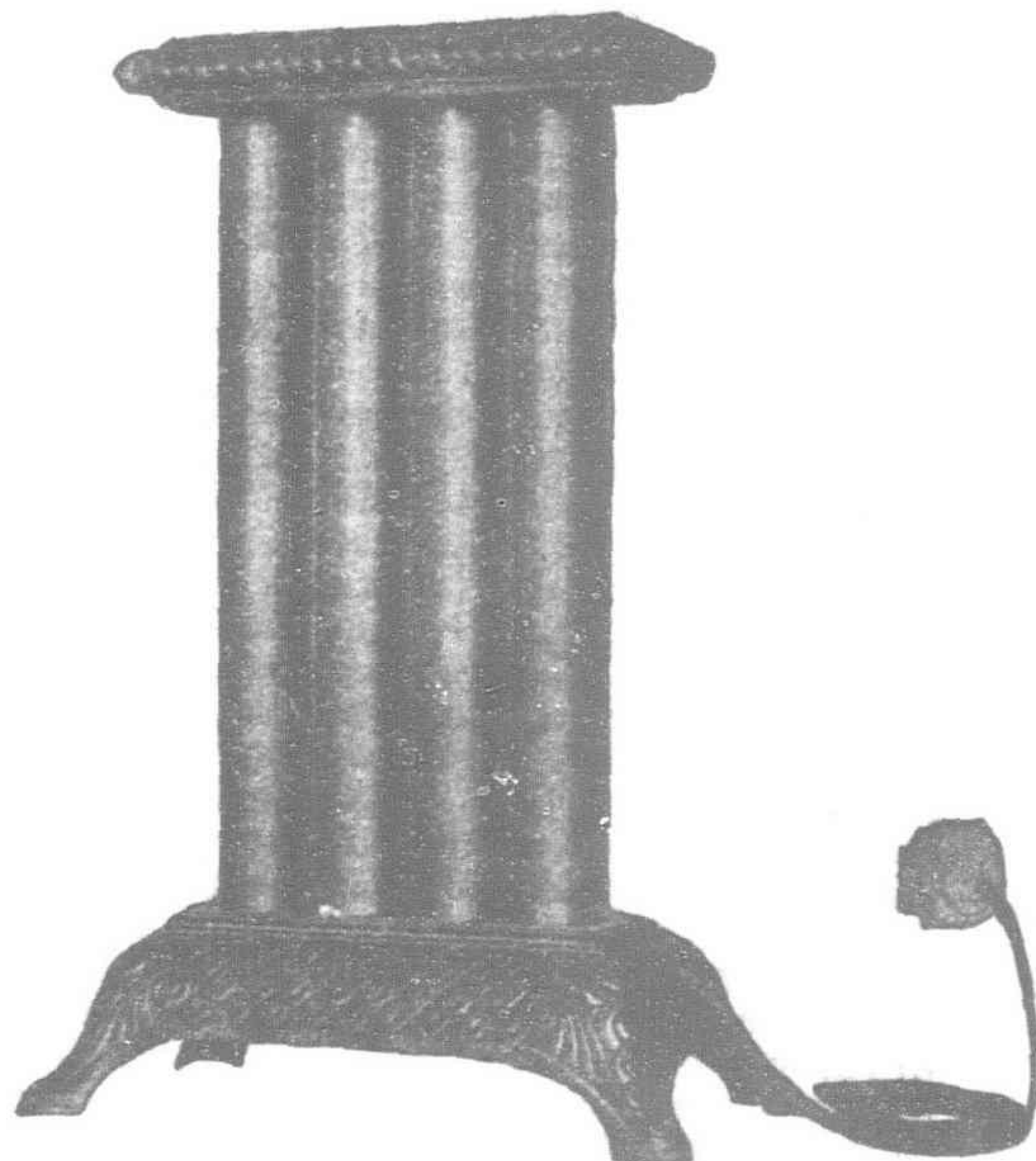
CORN POPPER



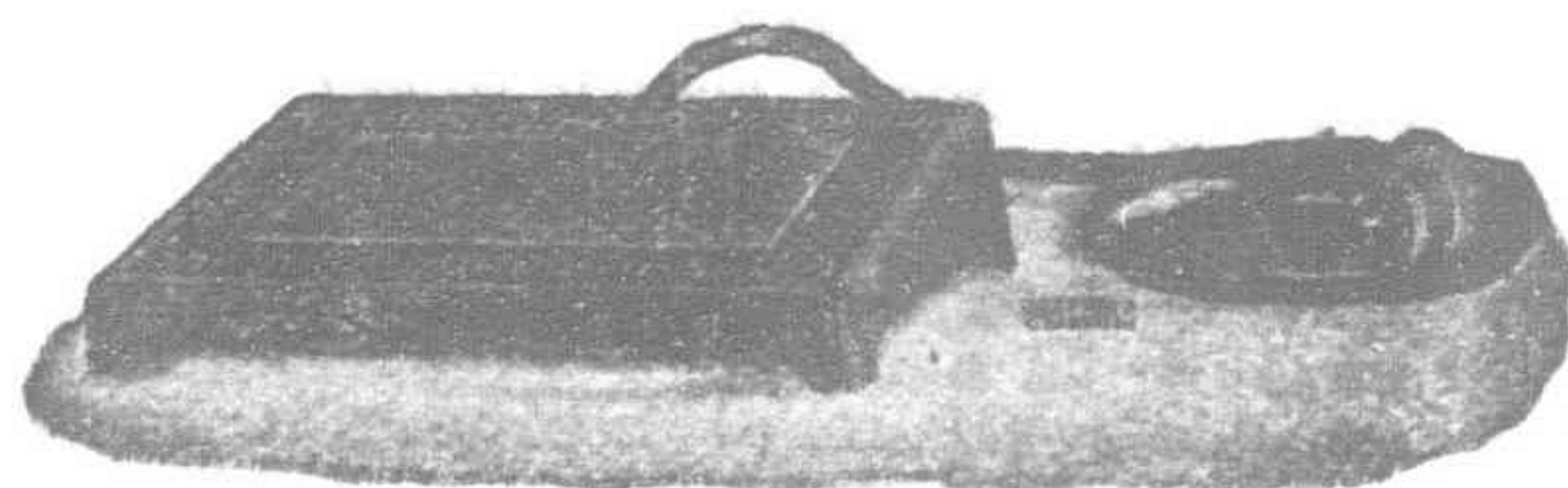
6-INCH DISK STOVE WITH 3-HEAT SWITCH



TWIN DISK HOT PLATE, WITH 3-HEAT INDICATING SWITCHES

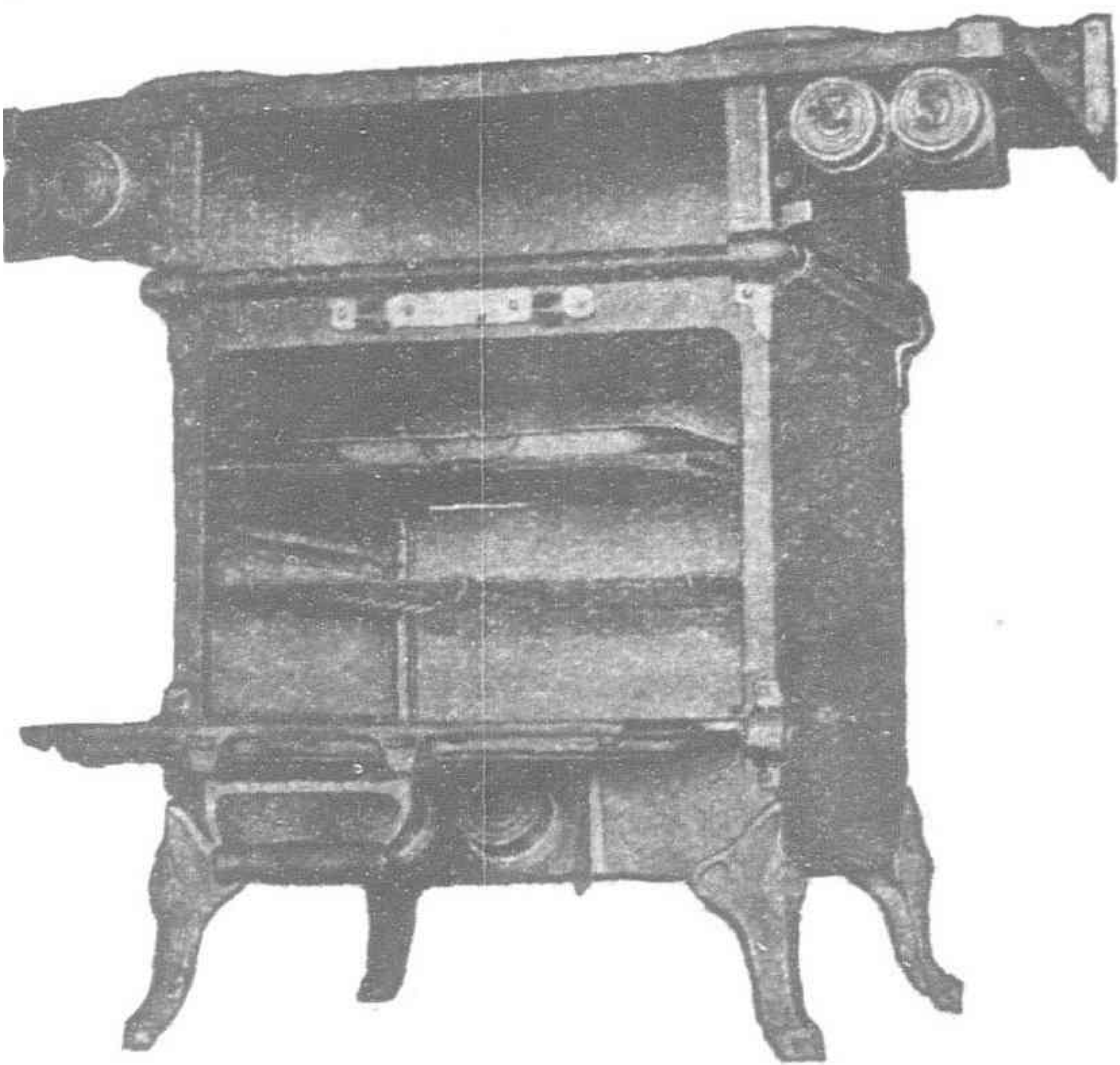
2-QUART WATER HEATER
Outside—SEAMLESS POLISHED SHEET ALUMINUM
Inside—SEAMLESS SHEET COPPER

FLOOR TYPE TUBULAR AIR HEATER

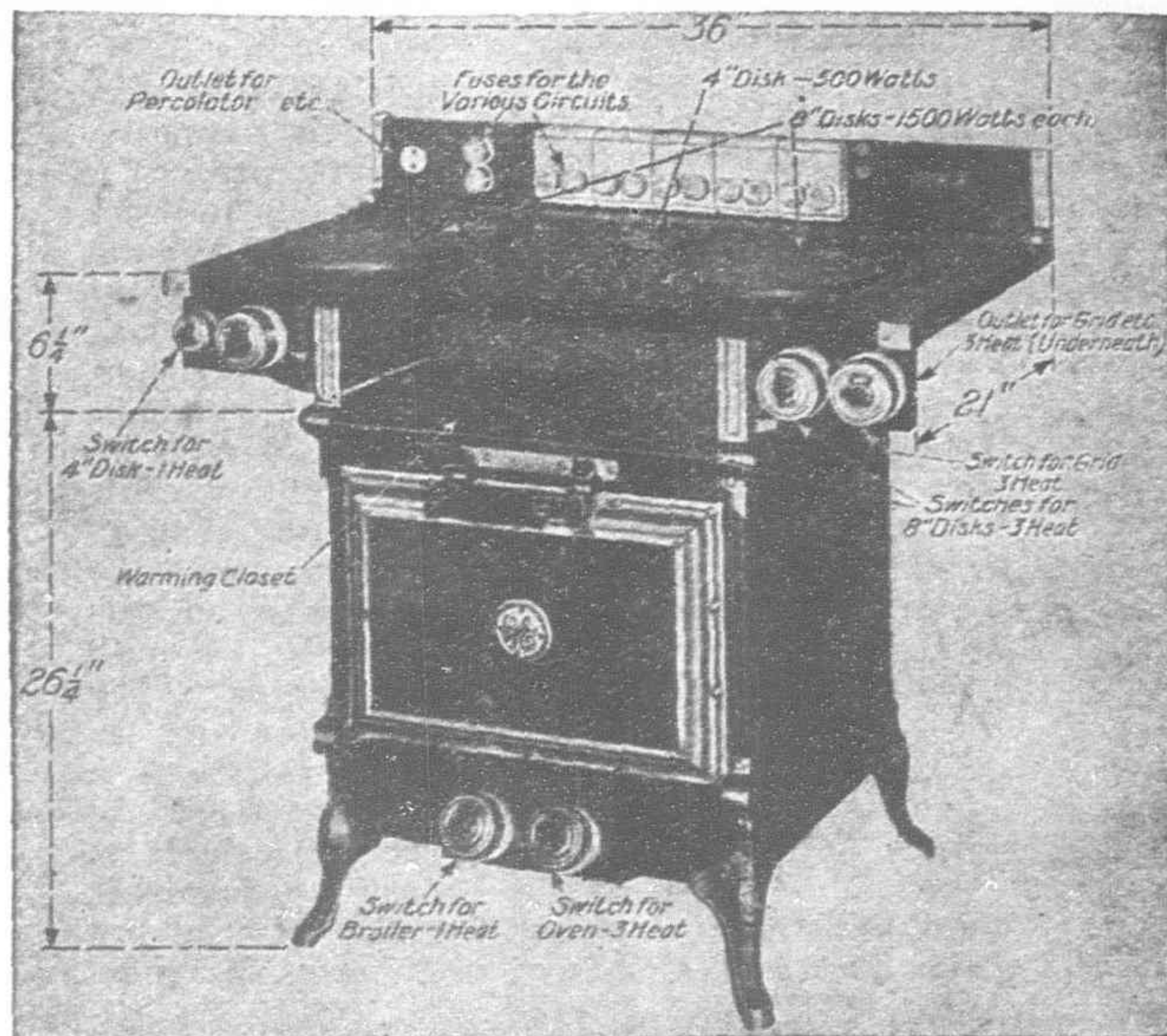


ELECTRIC FOOT WARMER

HEATING AND COOKING DEVICES



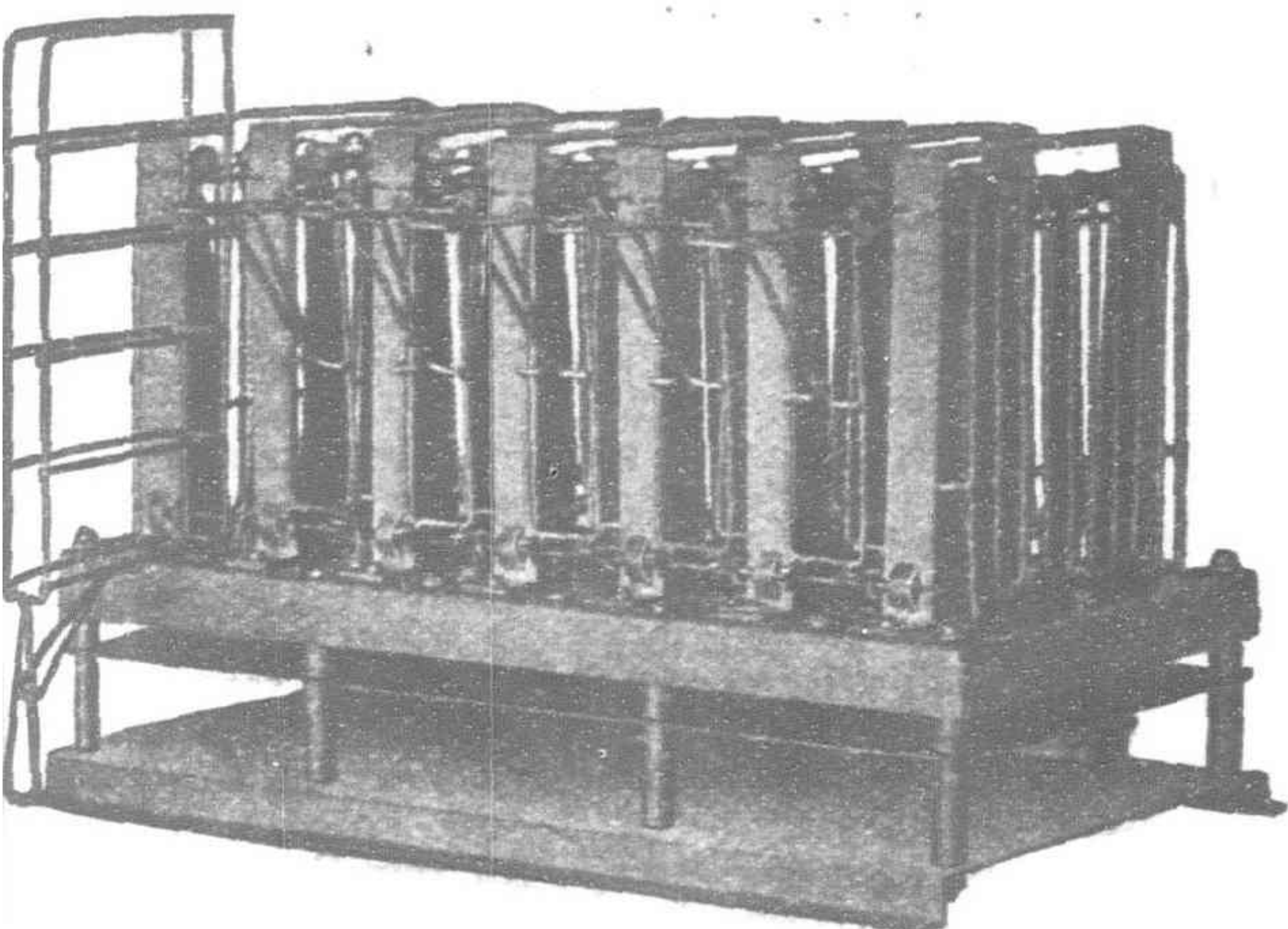
OPEN VIEW OF TYPE D-22 DOMESTIC RANGE



TYPE D-22 DOMESTIC RANGE



ELECTRIC OVEN WITH BROILER



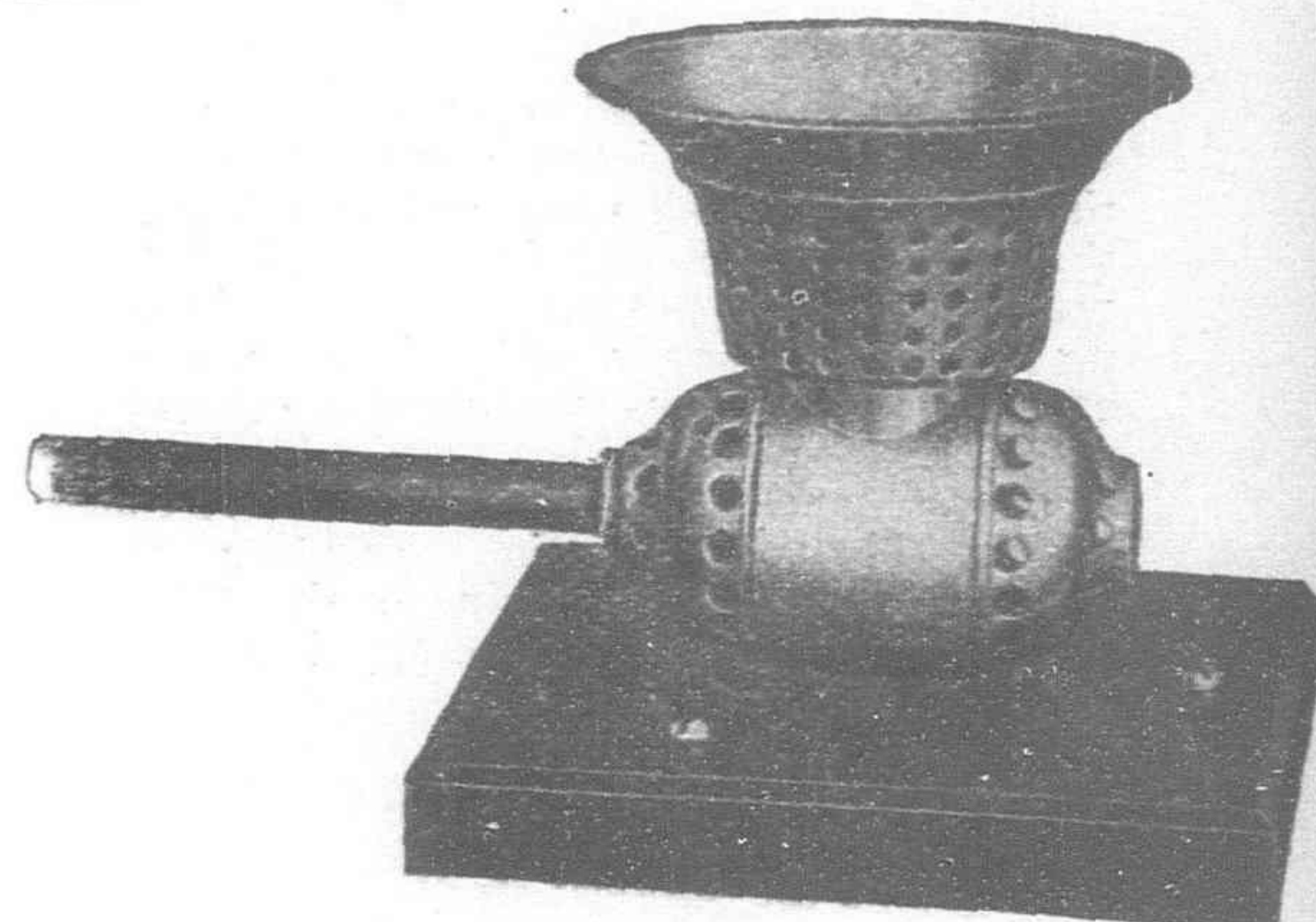
RADIANT WIRE TOASTER, RESTAURANT TYPE



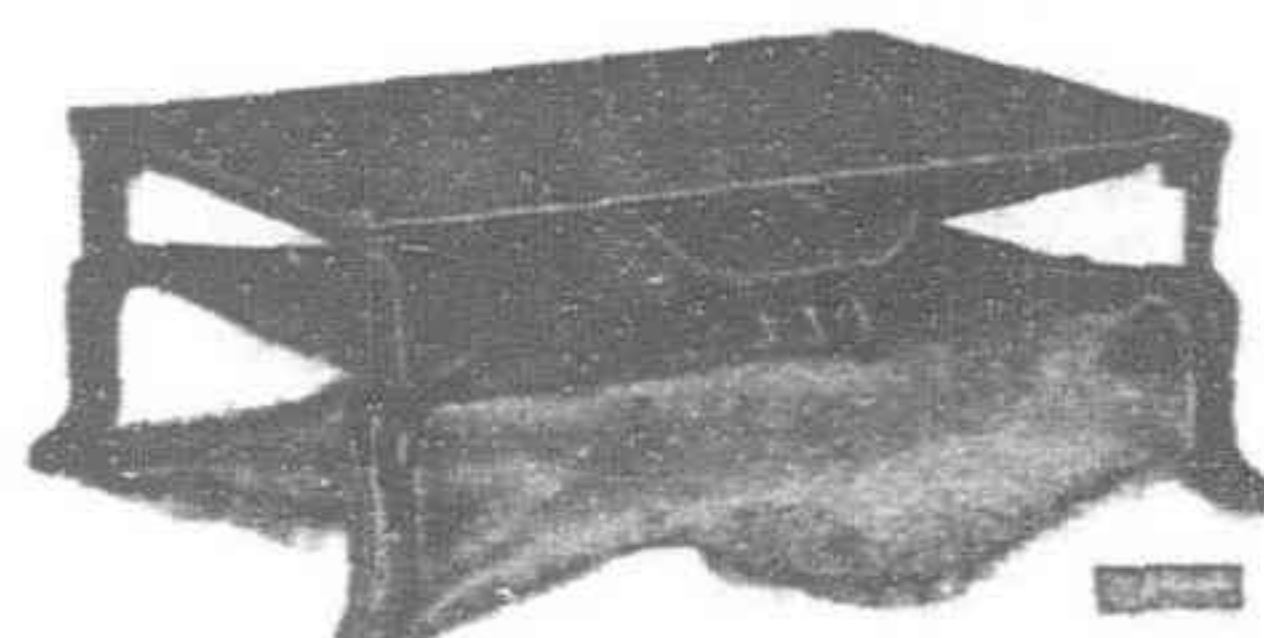
PINT WATER HEATER



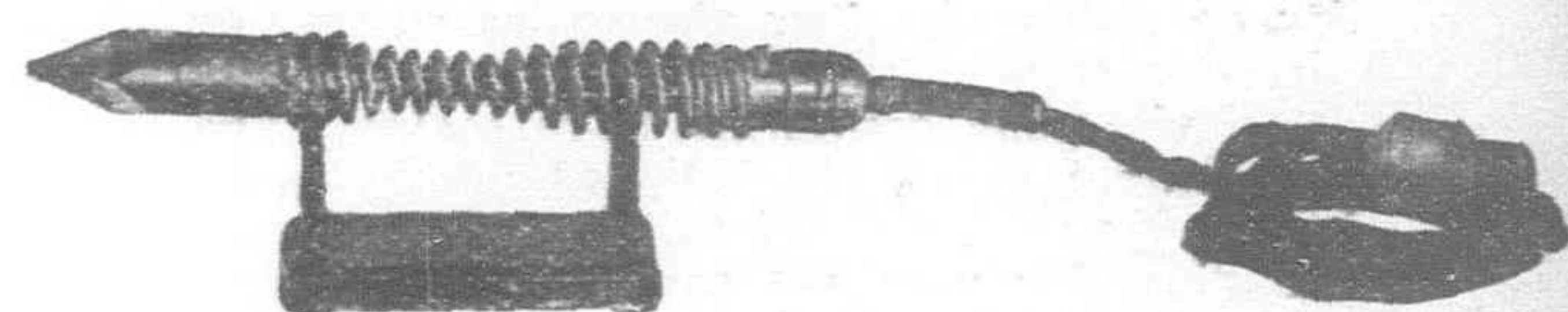
HOT WATER CUP



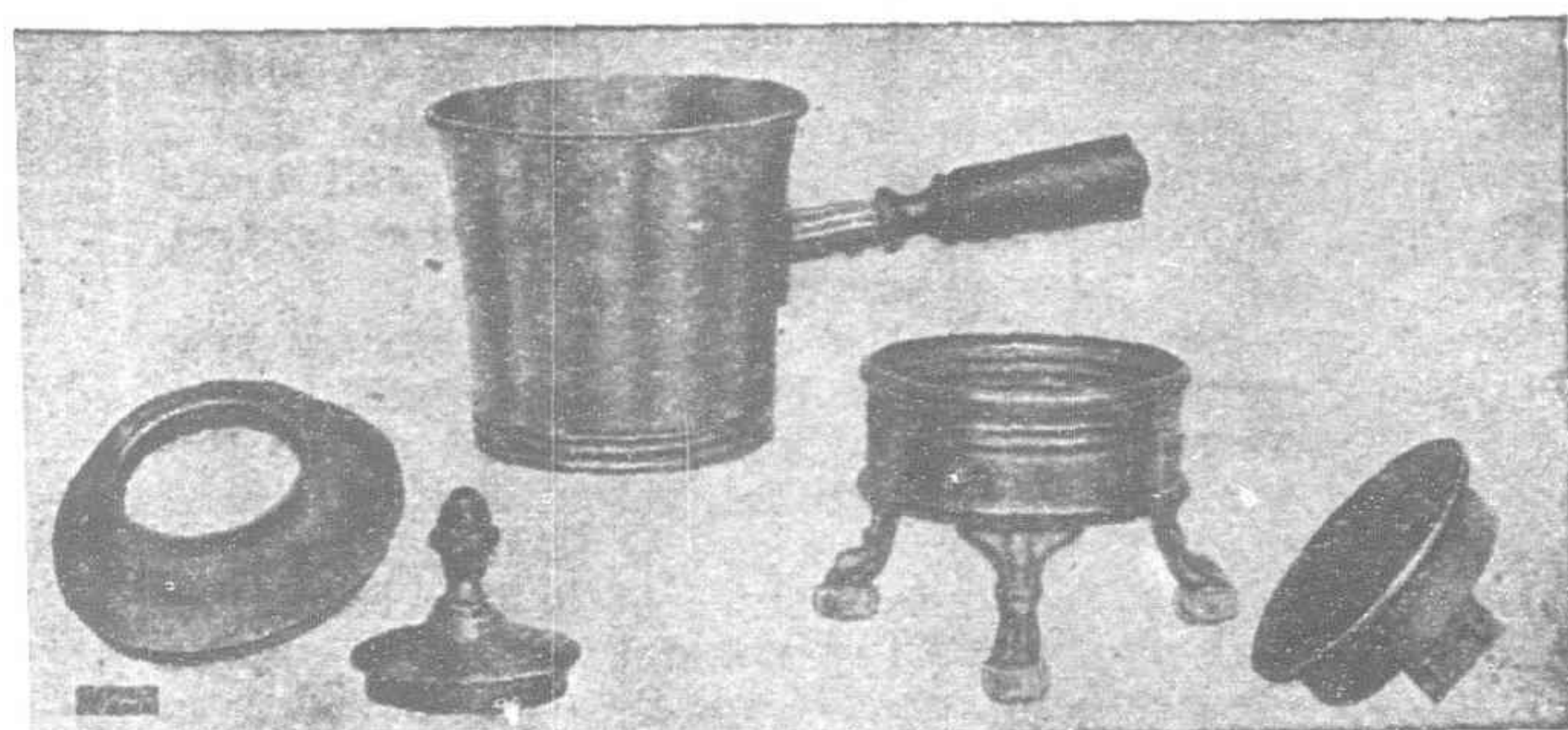
COSMETIC HEATER



ELECTRIC GRID



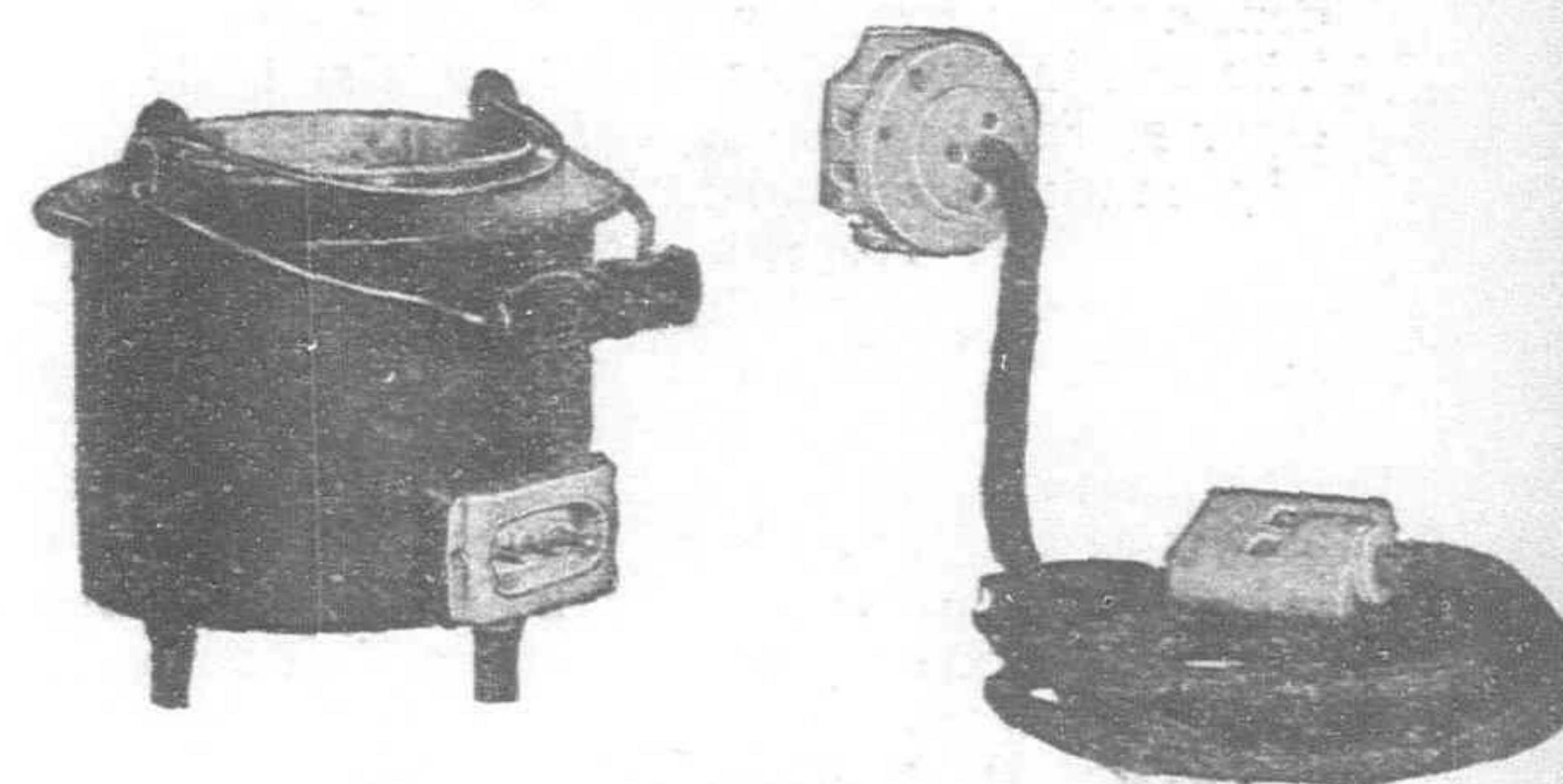
SOLDERING IRON ON SEPARATE STAND



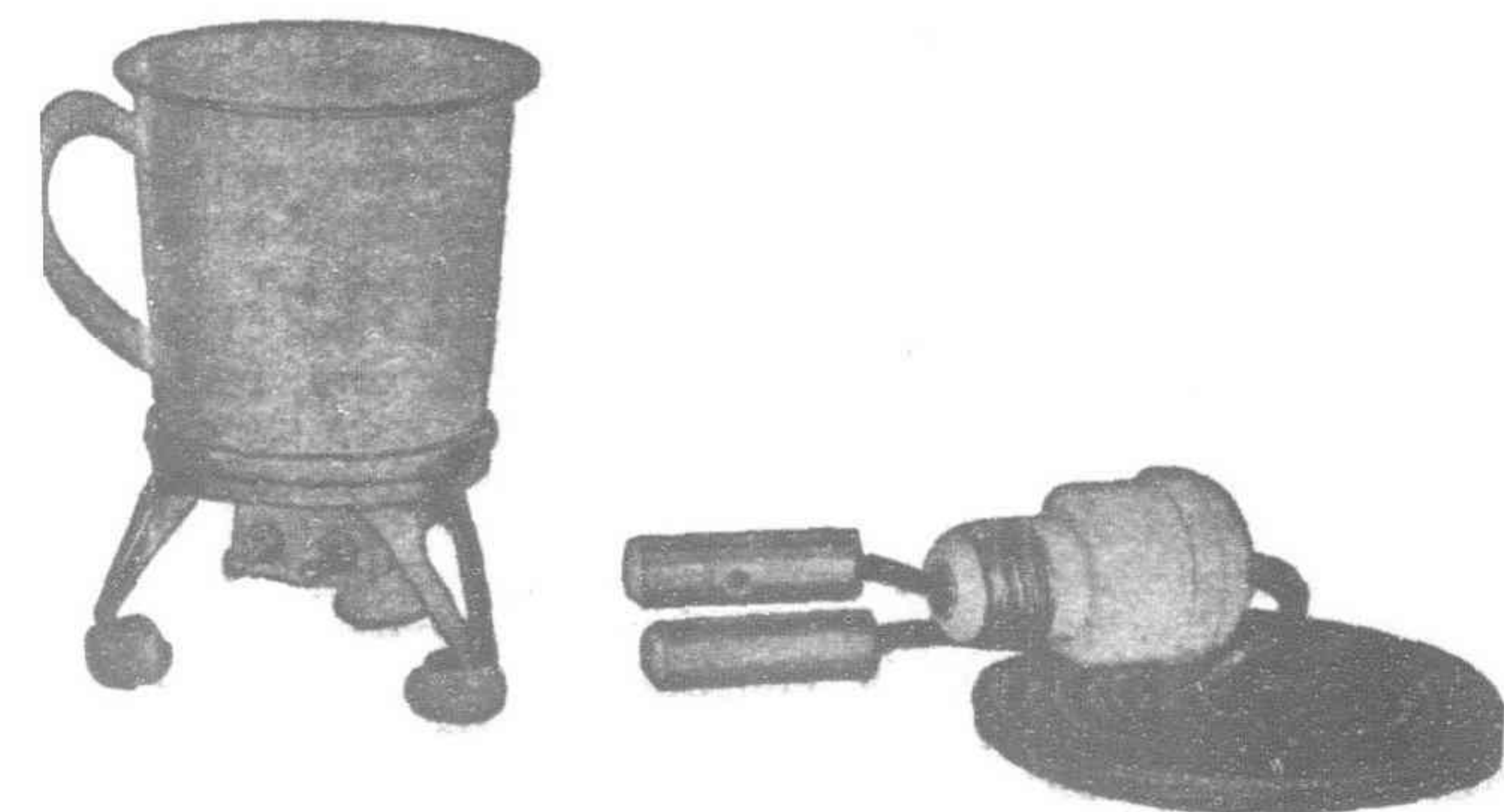
PARTS OF PINT AND QUART WATER HEATERS



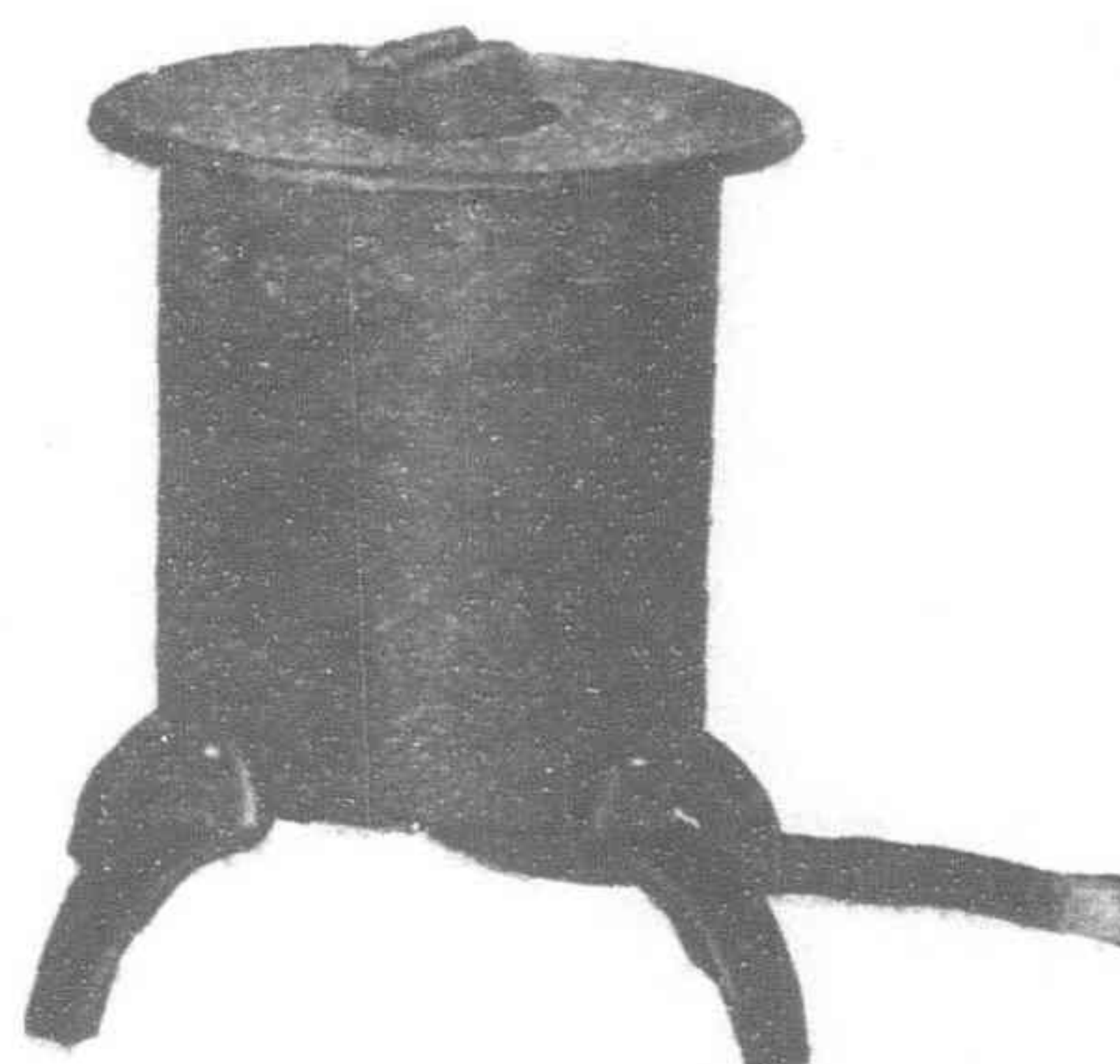
ELECTRIC BROILER



WATER JACKATED GLUE POT WITH 3-HEAT WALL RECEPTACLE



1/2 PINT HOT WATER CUP—CUP WHITE ENAMEL, SUPPORTS-NICKEL



SOLDERING IRON HEATER



SEALING WAX POT

MANUFACTURED BY THE GENERAL ELECTRIC COMPANY

applying the heat directly to the glue, thus saving the heat taken up by the water in the water jacket. This feature makes these devices very economical. Furthermore, although they operate very quickly, their design absolutely prevents them from burning the glue even if the heat is applied for a sufficient time to dry the contents of the pot into a solid mass. In such a case the addition of water renders the glue as good as ever. They are available in half-pint and two, four and 8-quart sizes. There heats can be obtained by the use of 3-heat switches.

G. E. Soldering Irons are made in stationary and portable forms. The stationary form is very useful in factories for soldering small parts rapidly and continuously. The tips are interchangeable, and copper tips may be substituted if desirable. Although nickel tips have a lower conductivity than copper, they are more advantageous on account of their non-oxidizing and non-corrosive qualities. The Portable Soldering Irons are available in five sizes, and are furnished with or without handle guard rings. The guard ring acts as a stand when the iron is laid on the bench. A separate cast iron stand is furnished, at an extra price, with the iron not provided with a guard ring. The $1\frac{1}{4}$ and $1\frac{1}{2}$ inch sizes are equivalent to the 3 and 4 pound coppers, respectively. Electric soldering irons remain hot all the time they are being used, and are free from the smut of the muffle furnace. There is no wasting of the copper tip, no waste of heat and no vitiation of the air. They heat quickly, are easily regulated by turning the current on or off, keep uniformly hot, require little current to operate, and can be kept clean or re-tinned easily. They enable the execution of an improved quality of soldering work. They are as indispensable in the home as a hammer or a screw driver.

The list of miscellaneous devices available includes several forms of cigar lighters, the cosmetic heater, the electrotherm or electric heating pad, the surgical sterilizer, and the foot warmer.

G. E. Cigar Lighters are made in pendant and desk or table types for intermittent service, and in goose neck, pendant and telephone types for continuous service. All types are suitable for operation on either alternating current or direct current circuits, and can be readily attached to any convenient lamp socket. The intermittent types are equipped with a push button for closing the circuit and thus heating the plug for use; the continuous types are always ready for use, but the current can be turned off at the socket when not in use. All types are furnished with suitable cord and attaching plugs. The intermittent types are intended for office and domestic use; the continuous types for hotels, cigar stores, etc. The continuous goose neck type is suitable for cigar stores, bar rooms, cafes, etc. It consists of a continuous pendant lighter suspended by a light spring, from a goose neck stand or support 24 inches high. This arrangement supports the lighter at a convenient level when the stand is placed on a show case or counter. The intermittent types provide 1,000 lightings at a cost of about one cent where the electricity is sold at 10 cents per kilowatt hour; the continuous types can be maintained at a cost of about 3 cents a day.

The G. E. Cosmetic Heater possesses many advantages which appeal strongly to actors and managers or owners of theatres, for use in "make-up" rooms. The portable type should be carried by every actor, and the stationary type should be installed in every theatre, thus greatly reducing fire hazard.

The G. E. Electrotherm or electric heating pad is the modern substitute for the inconvenient and troublesome hot water bottle. It is unquestionably the best device available for the local application of heat to the body. It is composed of resistance wire insulated and protected by asbestos woven into a flexible sheet or pad, which when attached to an ordinary incandescent lamp socket radiates an adjustable and constant degree of heat. Sensitive thermostats incorporated within the fabric operate automatically to maintain the heat

constant and to prevent it from exceeding the safety limit of 220 degrees F. The size developed for general use is 11 inches by 15 inches by $\frac{1}{4}$ inch thick. It is provided with an indicating regulating switch, connecting plug and fifteen feet of flexible cord. It is indispensable in hospitals, households and sick rooms. There is no liquid to leak out, and not the slightest danger of burning or scalding the patient. It is of great convenience for relieving general chilliness, cramp and similar ailments, and it is effective in cases of pneumonia, rheumatism, and neuralgia. It is simple to operate, and requires but little attention while in use. It consumes no more current than an ordinary 16 c.p. incandescent lamp, and the different degrees of heat attainable are indicated by the regulating switch. Full length electrotherms can be furnished on order. They are invaluable for operating room use in hospitals. For wet or moist applications a heating pad with a rubber covering should be used. This covering will be furnished on request. The use of the electrotherm furnishes an amount of comfort for the sick, and a refinement of treatment not obtainable otherwise.

The G. E. Surgical Sterilizer available is in the form adopted by the U. S. Army Medical Corps, and is designed to use either steam, boiling water or hot water as the sterilizing media. Its most satisfactory application is the sterilizing of surgical instruments. The electric heating element is applied to the water pan or base compartment, and the regulation of the heat provided will give hot water, boiling water or steam as may be required. The upper sterilizing chamber is double walled and is equipped with two wire-mesh racks for supporting the instruments. Steam from the lower chamber may be admitted into this sterilizing chamber by turning an indicator valve, or the steam may be shut off and the air in the chamber heated indirectly from the steam by conduction. This feature is of particular advantage in sterilizing bandages and dressings, as the sterilizing chambers can be raised to the boiling point before the steam is admitted, thus avoiding the condensation of steam on the articles being sterilized. The lower or water chamber may be used for hot or boiling water sterilization. The size of the sterilizing chamber is ample for all needs of the operating room. The overall dimensions of the complete sterilizer are $17\frac{3}{8}$ inches long, 8 inches wide, and $16\frac{1}{2}$ inches high. It is constructed of heavy sheet copper heavily nickled and highly polished. Each sterilizer is equipped with three indicating switches providing three heats.

The G. E. Foot Warmer is a portable device designed to give a moderate warmth as a foot rest, in rooms or offices not sufficiently heated or having cold or draughty floors. In the home it provides considerable comfort to persons of advanced age or of poor circulation. It is $10\frac{1}{2}$ inches by 14 inches by $3\frac{1}{4}$ inches high, japan finish with a top of open lattice work of Grecian design.

THE NEW SINGAPORE WATERWORKS.

The first public works for the supply of water to Singapore were undertaken in the year 1857. They comprised an intake in the vicinity of the present Thomson Road Reservoir and a masonry conduit to convey the water to town. Mr. Tan Kim Seng generously contributed \$13,000 towards the cost of this undertaking.

Alterations and extensions to these works were made from time to time, and pumps and distributing works were constructed in town prior to the year 1878, while in 1866 the masonry conduit was replaced by a cast-iron main, 24 inches diameter, laid along the Thomson Road.

The Thomson Road Reservoir, as at first constructed, was completed in the year 1868, but in 1894 it was enlarged by the construction of the present embankment at a point lower down the valley. A second line of cast-iron pipes, 24 inches diameter, was laid along the

Thomson Road, and brought into use in the year 1898.

A further enlargement of the Thomson Road Reservoir was completed in 1905 by raising the embankment an additional five feet, thus making the maximum depth $26\frac{1}{2}$ feet, and the total capacity 1,003,600,000 gallons. This enlargement was necessary for the reception of the water brought in from the upper portion of the Kalang River by the Kalang Tunnel Works, which were completed in 1907, ensuring a minimum supply of 5,500,000 gallons per day.

The necessity for securing additional sources of supply was recognised in 1901, and in the following year Mr. R. Peirce, M. Inst. C.E., the Municipal Engineer, outlined the present scheme of extensions, which received the approval of the Government in 1904, actual construction being commenced in 1906.

The Works recently opened form the first portion of this scheme.

The Map shows the locality of the new works, and of the further extensions yet to be undertaken in the valley of the Seletar Stream.

The new Reservoir is known as the "Kalang River Reservoir," and has been formed by constructing an embankment across the valley of the Kalang River at a point near to the $6\frac{3}{4}$ mile, Thomson Road. The total catchment area contributing to this Reservoir is 3,007 acres, comprising 1,538 acres in the upper part of the valley (known as Kalang Valley Extension), and 1,469 acres in the lower part of the valley. The water collected in the upper part of the valley may be intercepted and diverted through the Kalang Tunnel into the Thomson Road Reservoir, or may be allowed to flow into the Kalang River Reservoir.

The top water area is 253 acres, the maximum depth 27 feet, the total capacity 845,000,000 gallons, and the available storage 211 days supply when delivering at the rate of 3,500,000 gallons per day, which is the estimated safe yield of this Reservoir in the driest season, making a total of 9,000,000 gallons per day in the driest season, including Thomson Road Reservoir supply.

The preliminary surveys for this Reservoir led to the selection of a site two miles lower down the Kalang Valley as a suitable position for the embankment, and a series of borings were made at that point to ascertain the nature of the subsoil. These borings were sunk through loose material to a depth of 85 feet without reaching a sound foundation, so the site was abandoned. Trial borings were then made on the present site, and indicated that a sound foundation for the puddle wall would be reached at a depth not greater than 60 feet, which was considered satisfactory.

The site of the embankment having thus been settled, arrangements were made for the purchase of the whole watershed above this site, the tenants and cultivators received notice to quit, and in due course their houses were demolished and all trace of human habitation was removed. The original route of Thomson Road, from the $6\frac{3}{4}$ mile to the 8 mile, ran along a valley which now forms one arm of the Reservoir, and a diversion of nearly 3 miles was made so as to keep the road entirely outside the catchment area.

Description of Reservoir Works. The earthen embankment is 1,260 feet in length, 238 feet in width at the base, and 30 feet high, and contains 140,000 cubic yards of material. The site of the dam was first prepared by removing the soft, loose top soil and mud to a depth of from 6 to 15 feet, after which the trench for the watertight puddle wall was excavated and filled with puddled clay; selected earth, dug from the adjoining hills, was then deposited on each side of the central puddle wall as it was raised above the surface of the ground, being well consolidated by watering and rolling. The embankment thus consists of tenacious hill earth thoroughly consolidated, with a continuous core wall of clay puddle, the latter being continued below the original surface of the ground to a depth sufficient to form a tie with watertight material at the base.

(Continued on page 76)

THE FAR EASTERN REVIEW

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SUN YAT SEN'S RAILWAY DREAM.

The remarkable vicissitudes of railway enterprise in China bid fair to be added to by the activities of Dr. Sun Yat Sen, the ex-President of the Republic. From the exalted pedestal of politics Dr. Sun has ostensibly stepped down into the arena of humble yet potent industrialism, and, making up his mind to bend his talents towards the material rather than the political betterment of his country, has decided to promote railway construction throughout the length and breadth of the land as the best means of profitably absorbing his effervescing energies. Rightly enough Dr. Sun sees more promise of national advancement through the agency of the iron horse than by means of the much vaunted instrument of political reform. That, of course, has been urged upon Chinese statesmen and officials for generations past by the best of China's foreign friends, but never have the Chinese been able to grasp in its full significance what systematised railway communication actually means to a virile country and people. Dr. Sun Yat Sen seems to do so. He has, however, had the distinct advantage of the experience of travel in many parts of the world, and particularly in America has he been privileged to learn what a tremendous force for industrial and general development the railway is. He has observed the rapid returns from pioneering enterprises in the wide expanses of the States, and he rightly dreams of similar successes in China. They should in reality be greater. He has seen and appreciated the enormous benefits accruing and derivable from rapid track laying in those districts where there is a demand for speedy communication and rapid transport, and he reasons that what has been done in America to open up the wildernesses and make them blossom can be done in China to a much more profitable degree in those vast, thickly populated and intensely cultivated provinces now being served by nothing more satisfactory than a river, a canal, or, as is the case in the major part of the interior, by deep-rutted roads or narrow paths passable in the best of conditions only by virtue of the utmost patience and the expenditure of unlimited time.

Dr. Sun is a convert to the rapidly laid track, and he seems to see in it the panacea for most of China's ills. Taking the cue from other lands he is arguing with his fellow-men that wealth not only comes from the soil but from the depths below the soil, and he is urging them to understand that the development of mining, the establishment of factories and manufacturing concerns constitute the natural corollary of railway expansion. He, with impetuosity that is laudable, wants railways to be spread about the land as fast as they can be built. He realises, too, in addition to

the sordid benefits accruing, that the death-dealing famines can be stayed in their wrack and ruin of human life and national vigour by an adequate system, and that system, he declares, he is bent upon introducing.

It is at present the idea of Dr. Sun Yat Sen that great trunk lines and provincial and inter-provincial systems, can be, and should be, built without Governmental interference. He aims at private control, or, at most, provincial control, and is developing a plan (which we hope to be able to present to readers and discuss at a later period) whereby private capital shall be employed to construct the lines with freedom from vital interference from Peking, or elsewhere. From the provinces, therefore he must seek the franchises and from the Central Government the acquiescence and support with which to attract the capital; and once he has the inducements at his disposal it is his intention to invite foreign capitalists to consider the feasibility of the scheme he will then have to propound. The opposition which has been shown in the past to inter-provincial railway enterprises having emanated from the provinces Dr. Sun is determined to risk no such disastrous obstruction in the future, and his energies are being devoted as a preliminary to the guidance of the provincial mind to that point where antagonism and agitation will be stayed sufficiently long to enable the knowledge to insinuate itself that the country will eventually get something of vast and increasing value for virtually nothing. That is the bait which Dr. Sun will hold out to the provinces to secure their compliance. He will endeavour to make terms with capitalists to build and work the roads to their own profit, and, within a given period, to hand them over to China as going concerns, free of cost or encumbrance. And he hopes to succeed. He knows that the Chinese cannot find the capital to finance anything like the system he has in mind, and he has lived to realise that they cannot secure value for their money, even if they have an abundance of it to dispose of, when they try their own prentice hand on railway work. The salvation is in the aid of the foreign capitalist and railroad engineer, and though it will not be put to the provinces in so many bald words, that is what is meant. The critics and the agitators among the provincials will be silenced by the fact that after a given time they will acquire railways without having had to pay for them. At least, that is considered by Dr. Sun as sufficient inducement to secure their consent, if not their active co-operation, in pushing a utopian scheme through to the utmost limit of success.

The ex-President does not intend to satisfy himself with any half-baked or diminutive plan. He sees in his mind's eye a net-work of rails covering the great expanses of his country—the provinces interlaced, and the far-flung frontiers of

the west in touch with the sea-board on the east. Trunk lines will stretch from Shanghai to Canton and away out with the setting sun through Yunnan to Lhasa and curl round the extreme edges of the Lid of the World into Sinkiang; from Shanghai direct through the heart of the rich provinces of the Yangtze valley, branching off north-west through Szechuan to Tibet to link with the line from Canton at Lhasa and direct north to open the wealthy productive areas in distant Sinkiang, and there connect with the line coming from Tibet along the Western frontier limits; from Tientsin north-westwards to Mongolia to link up in Sinkiang with the trunk lines sweeping from Shanghai; from Tientsin north-eastwards through Manchuria and also through the eastern part of Mongolia. These are roughly the main lines Dr. Sun projects in addition to the trunk system now being laid down in the provinces. But Dr. Sun dreams of still greater conquests. He sees each province a model of internal communication, and aims at developing a connected system such as no country in the world possesses. To-day it is a dream; tomorrow Dr. Sun hopes to see it all a living reality. He has so far secured the consent of Kwangtung, Kwangsi, Yunnan and Kweichow provinces to operations in the southern section of the country, and he is now preparing to overcome any objections in the Central and Northern provinces. When he elaborates his plans he proposes to visit Peking to place the whole project before the President, the Cabinet and the Advisory Council, and if he can persuade the different factions congregating in the capital to sink their provincial differences in this great matter he will have accomplished what no other man has so far succeeded in even commencing, and his life will not have been lived in vain, even if he fails to drive one spike in the lines he has drawn upon his map as desirable and possible. But whatever the ultimate result of Dr. Sun's dream, certain it is that his efforts will awaken an immediate and wider interest in railway projects in the land, and it is quite possible that if the fever for communication sets in the many feasible and potentially profitable projects which have for so long been hung up in the atmosphere of doubt and disappointment will within reasonable time be revived and carried into effect. Without even thinking of touching the sparsely populated and mountainous regions of Tibet, the wide uninhabited areas of Sinkiang, and the barren deserts of Mongolia, there is a life's work in the Central provinces alone, and if Dr. Sun can succeed in accomplishing a tithe of what lays there to his hand he will have conferred an inestimable blessing upon his country and will have contrived a monument to himself of a more substantial and enduring character than he could possibly ever have expected to have come to him as a result of efforts in the political phases of his country's activities.

PHILIPPINE SUGAR

One of the most valuable official publications of the Philippine Government is the "Handbook on The Sugar Industry of the Philippine Islands" recently issued under the direction of the Bureau of Agriculture. This comprehensive treatise on the most important industry in the Islands, is of the greatest value and assistance in arriving at a fair knowledge of the conditions surrounding the cultivation and manufacture of sugar under the primitive methods still in vogue, and in furnishing the agricultural data necessary for basing estimates of production and manufacture under more up to date methods. The lack of accurate data based on intelligent observation was a great handicap to the government and those friends of the Islands, instrumental in aiding the passage of the Payne Bill through Congress, and gave strength to the arguments of the opposition whereby the measure was defeated for several years. The information now published in the Handbook, especially the report of Mr. Herbert Walker, on the "Sugar Industry in Negros," should have been compiled and issued ten years ago, as it was clear to all who had the best interests of the Islands at heart, that the only way to refute the arguments of the opposition, was to have a thorough official report on the Sugar Industry, from a responsible and competent sugar chemist, specially assigned to the work.

There is little doubt that sugar is the premier crop of the Islands, whose future prosperity will be determined largely by the successful exploitation of this particular industry. And yet while money was freely expended by the Bureau of Agriculture, in experimenting with all other crops, and a great amount of valuable literature published, the sugar industry was passed over and neglected until 1909. In a foreword to the Handbook, the Director of Agriculture, Dr. G. E. Nesom, says "the Bureau of Agriculture has had charge of La Granja Modelo, the old Spanish sugar experiment station in Negros, since 1903, but has been without adequate means or equipment to carry on satisfactory lines of field or mill work." While the political future of the Islands remains uncertain, and tariff questions relating to Philippine products imported into the United States continue a subject for debate, the local Government here cannot actively encourage the development of the sugar industry along the lines it most deserves." This bears the date of July 1911, two years after the passage of the Payne Bill, permitting the free entrance of 300,000 tons of Philippine sugar into the American market.

Are we to infer from this statement that the Insular Government, owing to the uncertain political future of the Islands, does not intend to further interest itself in the development of the Sugar Industry now that the Payne Bill is a reality? Such a statement would suggest that the Philippine government cannot

promote the welfare of those under its charge, and is tantamount to a charge of subordinating the welfare of the Filipinos to the mandates of the beet sugar trust in America. The reasons given as to why the local government can not actively encourage the development of the sugar industry, can not be accepted, as it would constitute an indictment of the administration policy in the Islands. We can see no good reason, why the Philippine government should not do all in its power to encourage the one manufacturing industry that will bring the greatest prosperity to those under its charge, and our candid opinion is that Dr. Nesom's "Foreword," simply lacked careful editing. The publication of the Handbook in itself refutes the statement so carelessly made in its Foreword, so the reading investor may take heart and pass over to those pages which contain information of the greatest value. A short historical sketch of the Sugar Industry in the Philippines from the pen of Mr. Harold M. Pitt, makes interesting reading, and the chapter on "The Modern Cane Sugar Industry" is of great value to the native planter who desires to secure a fair working knowledge of modern sugar making and cultivation of his fields.

By far the most interesting and instructive portion of the book is that devoted to the "Sugar Industry in the Island of Negros." It is of particular interest, as it is the only treatise dealing entirely with sugar, which has been published since the American occupation, as the result of investigations by a competent authority. The necessity of this work as already stated had been emphasized time and again, and in 1908 the government detailed Mr. Herbert S. Walker of the Bureau of Science to this duty. Mr. Walker was stationed in Negros during the entire sugar campaign of 1908 and 1909. Equipped with a portable chemical laboratory he visited the various haciendas, and secured at first hand a wealth of valuable data on the soils, cane analysis, mill and sugar house control, and other important information which will serve for some years as a guide to the industry of the Islands. With the erection of the new central factories operated under expert chemical control, further valuable data will be forthcoming, to supplement the highly valuable work of Mr. Walker.

Mr. Walker's careful studies reveal the fact that Negros cane is the best in the world, giving the high average of 16.06 per cent in sucrose with an average low fiber content of 10.02 per cent. In Hawaii with the most careful cultivation, irrigation, selection of seed, etc, the best canes grown during the campaign of 1909, showed only 16.01 per cent of sucrose, and these had been in the ground twenty months before cutting. The fiber in the Hawaiian cane is given at 12.5 per cent on an average, with a maximum of 15 and minimum of 10 per cent. In Egypt the average sugar content of the canes is given at 14 per

cent, and in Java the average is only 12.30 per cent, and 12.01 per cent of fiber. In Louisiana the sucrose in the juice averages 11.78 per cent and in the British West Indies 14.39 per cent.

This comparison establishes the fact, that nature has endowed the islands with the richest and best sugar canes in the world, with a sucrose content 25 per cent in excess of the average in some other parts of the world. If such cane is grown in the Islands without any attempt at scientific cultivation, there is reason to believe that under proper methods, a much richer variety can ultimately be grown. The Louisiana planter, struggling along with only 11.78 per cent in sucrose might well argue that the Philippine industry does not require official encouragement when nature has given the Islands an initial advantage over them of 33 per cent of sugar in the canes. And on the face of it, if we accept Mr. Walker's report as correct—it is official—the sugar industry in the Islands needs little encouragement. With a native cane free from disease containing 16.06 in sucrose and only 10.02 per cent in fiber, a modern factory should secure over 14 per cent in sugars on the weight of the cane, making the sugar industry in the Philippine Islands, under free trade with America, the most profitable industrial investment in the world to-day. If Mr. Walker's figures hold true, a modern sugar factory controlling its own lands, and paying the current scale of wages in the Islands, and selling its sugars to the refiners in America, should clear at least 150 per cent per annum on the capital invested. If Java, with cane containing an average of 12.30 per cent sucrose can develop an enormous industry, and market their sugars in America, paying the full duty of \$38.00 gold per ton, and make an average 20 per cent on the investment, what should be the result in the Philippines, where the sugar content of the cane is nearly one-third greater, and there is no duty to pay. If there is any other industry in the world to-day that promises such great returns on the investment, we have failed to hear of it.

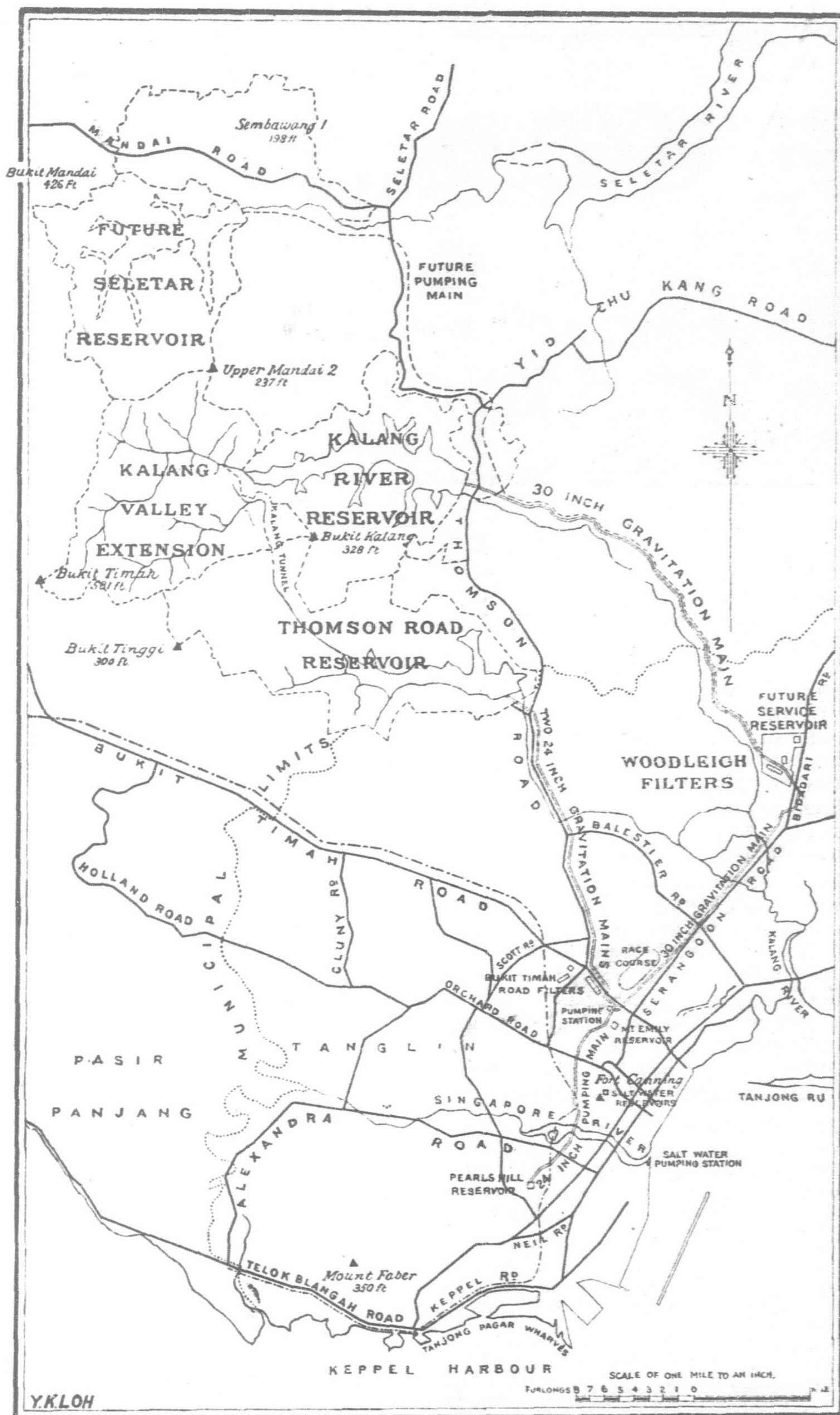
Mr. Walker's figures, if correct, constitute the greatest advertisement of the Islands yet published. We believe that the government should detail another chemist to go over the same ground, and compile a supplementary report, to check or verify Mr. Walker's figures. If other competent authorities corroborate Mr. Walker, the government after publishing the report can conscientiously refrain from any further active encouragement of the industry, for nothing it could do or say would surpass in importance this fact.

We have heard the statement repeated several times, that Philippine cane was vastly inferior to that of any other country. A few years ago, a sugar man from Hawaii spent some time in Negros, studying conditions. He claimed that there was hardly a cane field free

from disease, and his report has spread amongst the sugar men of America, and is now a firmly rooted belief. Mr. Walker's report not only establishes the fact that Negros cane is superior to any other in the world, but emphasizes the point that very little damage has ever been reported as having been caused by disease or insects.

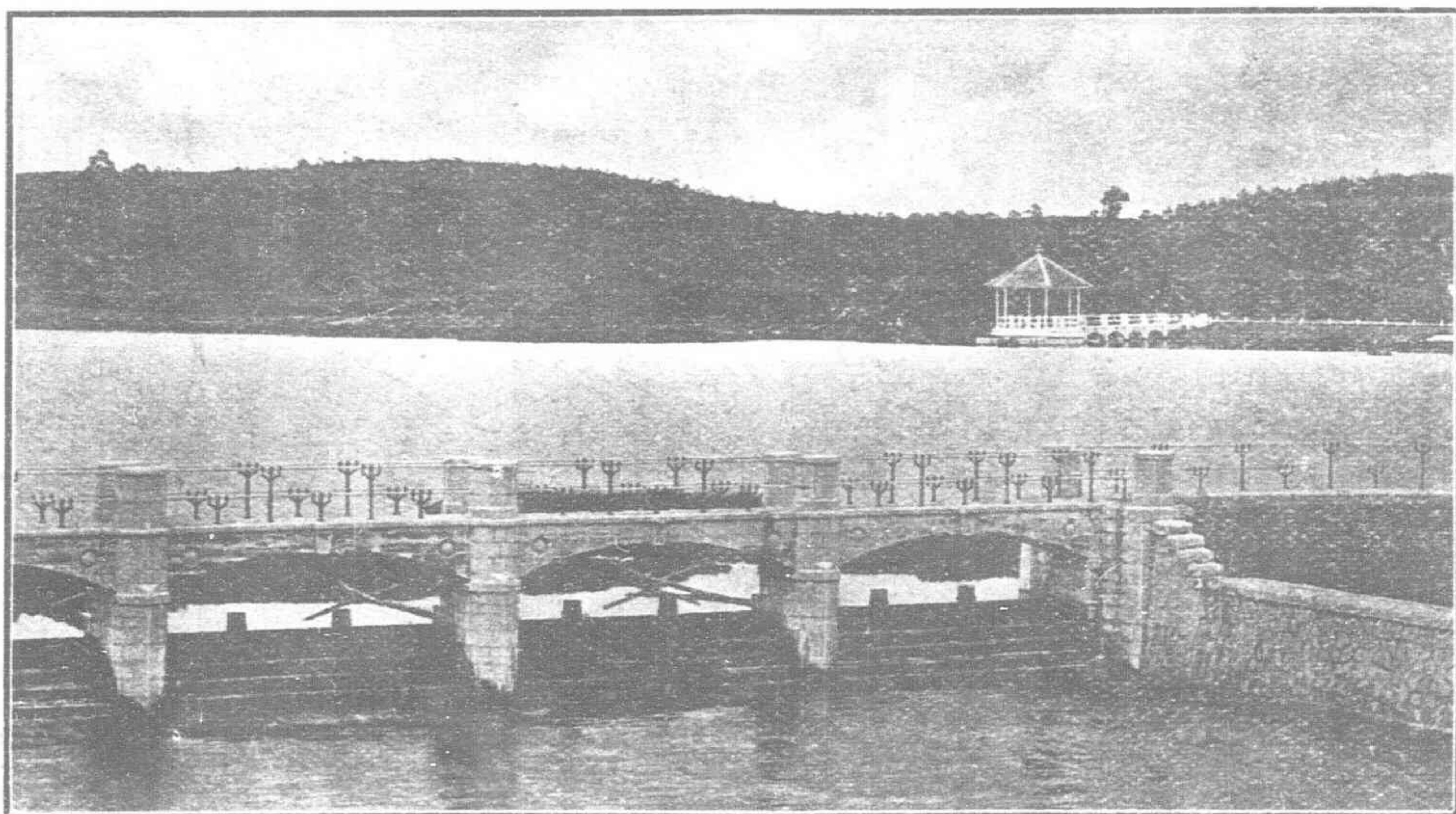
Mr. Walker also deals with the soil conditions of the Island, which compared

with soils from other countries, are fully as rich, and under proper cultivation should produce as much sugar as those of any other country having the same climatic conditions. The analysis of the canes, with their high percentage of sucrose and low fiber content, explains why the Negros planter has been able to secure a juice extraction of 64.5 per cent on the weight of the cane, with mills averaging about 10 H. P. The best



SINGAPORE MUNICIPALITY

Plan showing Catchment Areas, Reservoirs, Gravitation Mains, Filters, Service Tanks and Pumping Station



SINGAPORE WATERWORKS: KALANG RIVER RESERVOIR

modern three roller mill working independently extracts an average of 68 per cent, and mills such as are employed in Negros about 50 to 55 per cent.

Where the West Indian planter working with a similar outfit, can only secure an average of 5 to 6 per cent in Muscavado sugars, on the weight of the cane, his antipodal prototype secures 10 per cent, in sugars on the weight of the cane, though at a polarization averaging 82 degrees. Nature has endowed the Islands, with soil and climate conditions which insure them a monopoly of the world's hemp supply, and scientific research now discloses that Nature has still further blessed these Isles of the southern Seas, with the most favored lands for the cultivation of the sweetest sugar cane in the world. Truly, the Lord is good to the "Tao."

THE SINGAPORE WATERWORKS

(Continued from page 72)

At one stage of the work an unexpected subsidence of a portion of the bank gave some concern, but the construction of drains and the weighting of the toe of the dam arrested further movement.

Since completion, observations have been taken which show the settlement and consolidation of the dam to have occurred with satisfactory regularity, and to have amounted in twelve months to about 4 inches.

The puddle trench has been carried to a depth of 47 feet at its deepest point, and has a maximum width of 15 feet 9 inches. Steel interlocking sheet piling was used to support the sides of the trench during sinking, and at the time when the whole length of trench was open 500 tons of these piles were in use. Heavy and continuous pumping was necessary to keep the trench free of water. The object in view was to give the clay puddle a foundation in an impermeable strata, and this was effected throughout the whole length of the trench. At the South end of the trench granite was reached, the surface of which was cut out to form a groove for the seating of the clay puddle wall.

The clay for puddle was obtained from clay pits situated near the third mile, Serangoon Road. As it was rather soft it was mixed in a pug mill with an equal quantity of tenacious red earth before being placed in the trench. The total quantity of clay puddle used in the work was 25,000 cubic yards. The inner slope of the embankment is pitched with coral, bedded on laterite beaching.

The overflow from the Reservoir passes over a sill 100 feet long, and discharges through a byewash channel, 40 feet wide, into the old course of the Kalang Stream below the dam. A steel bridge was constructed to carry Thomson Road over the byewash channel.

The valve tower is provided with draw-off pipes at various levels, thus enabling water to be drawn always from the top, where it is more clear and pure. The water is passed through copper screens in the tower before entering the supply pipes.

The supply pipes from the valve tower pass along a tunnel driven through the hill round the north end of the dam. The tunnel is 520 feet in length and 11 feet in internal diameter. For the greater part of its length it is lined with cast-iron rings, of which 547 tons were used in the work.

The tunnel terminates in a meter chamber, where a 36-inch Venturi Meter has been fixed. The meter will show on a diagram the quantity of water drawn daily from the Reservoir.

While these works were under construction the whole of the area to be submerged was cleared of all trees, roots, and undergrowth, nothing but short grass being left on the site.

Water was first allowed to rise in the Reservoir in January, 1910; and, as it rose, large quantities of loose turf, or "sudd," floated up from the bottom, and had the appearance of islands floating on the surface of the water. This material was subsequently towed to the side of the Reservoir, cut up and removed.

The execution of these works necessitated the employment of a large staff, for whom quarters coolie lines, and hospital accommodation were provided. A temporary railway, 4½ miles long, was constructed from Serangoon Road, opposite Bidadari, along the pipe track up to the site of the Reservoir, and the bulk of the materials of construction was conveyed thereon.

Woodleigh Filters. From the Reservoir the water passes along 30-inch diameter cast-iron pipes to the land selected for the filters, which is near the 3½ mile, Serangoon Road, approached originally from the back of Woodleigh House, and is an irregular shaped hill, from which the surface drainage runs off in all directions. The site was inspected by Professor Simpson, C.M.G., and was very favourably reported upon. It is particularly suited for these works, is well isolated and can receive no drainage from surrounding properties.

The filters are "slow and filters," nine in number, having an area of nearly seven acres, and are capable of dealing with 4,000,000 gallons of water per day during the worst periods, and a considerably larger quantity during the best periods of the year.

Filtering Materials. The filtering material is placed in the filters in the following manner:—On the bottom of the filter a false floor is first

constructed of two courses of bricks, laid honeycomb fashion. The false floor supports three layers of broken granite, coarse below, medium between, and fine stone above, upon which is placed a layer of sand, two feet in thickness, as the actual filtering medium.

The quantities of material required were very large, thus 1,720,000 bricks were used in the forming of the false floors, supporting 10,000 cubic yards of broken granite and 28,000 cubic yards of filtering sand, the latter obtained from pits at Tampenis and Changi.

All these materials were carefully washed and cleansed before being laid. The water for washing the sand is raised by special electrically-driven pumps to a small reservoir on a hill above the filters, whence it gravitates to the Walker washing-hoppers, of which two batteries of 12 each have been installed at the site of the works.

Method of Filtration. In operation, the unfiltered water enters the filters above the sand, and passes downwards through the filtering materials, the filtered water being collected into the outlet chambers and drawn off through floating outlet pipes, which, by means of an orifice in a drum attached thereto, automatically maintain a constant rate of discharge.

A filter should work continuously for periods of from four to eight days each, with 24 hours aeration between each period. About once every three months a filter requires cleansing by scraping off about one half-inch from the surface of the sand.

The rate of filtration varies according to the character of the water and the time of year, the limits being 150 gallons per square yard per day as a minimum and 450 gallons per square yard per day as a maximum.

Woodleigh Clear Water Tank. After filtration the water is stored in the Clear Water Tank, whence it is discharged to the existing Pumping Station in Mackenzie Road through pipes of 30 inches in diameter.

The Clear Water Tank is divided into two portions to facilitate cleansing, and has a total capacity of 4,000,000 gallons, with a depth to overflow level of 6½ feet. Special care has been taken to secure efficient ventilation.

The daily discharge from the tank will be registered by a 30-inch Venturi Meter, which has been fixed on the supply main near the entrance to the works.

Near the site of the works permanent coolie lines, superintendent's quarters, and offices have been built.

Gravitation Mains. The water will be conveyed from Kalang River Reservoir to the filters by a main 30 inches in diameter, 3¾ miles in length, and from the filters to town by a similar main 3 miles in length.

Cast Iron Pipes have been used for all mains. Where laid across the swamps, the pipes have been carried on piled foundations, and protected with earth banking. Where laid beneath rivers, special foundations and concrete casing have been required.

The total weight of all Cast Iron Pipes used throughout the works is 7,000 tons, and of Sluice and other Valves, 100 tons.

These gravitation mains are designed to deliver to Town a quantity of 3,500,000 gallons per day when the Reservoir is at its lowest working level, and are capable of delivering much more at ordinary times.

The water will be delivered at the existing Pumping Station in Mackenzie Road, whence it will be pumped to the existing service Reservoirs at Mount Emily and Pearl's Hill for distribution in Town.

Available Supply. The total cost of these works, excluding the purchase of land, has been \$3,300,000, and the total supply of water now available from both old and new works is 9,000,000 gallons per day in the driest season. An additional supply of at least 3,000,000 gallons per day will be obtained from the works in the Seletar Valley to be constructed hereafter. Mr. Robert Peirce, M. Inst. C.E., the Municipal Engineer, was Engineer for the works, with Mr. Stephen G. Williams, Assoc. M. Inst. C.E., as Chief Assistant and Resident Engineer.

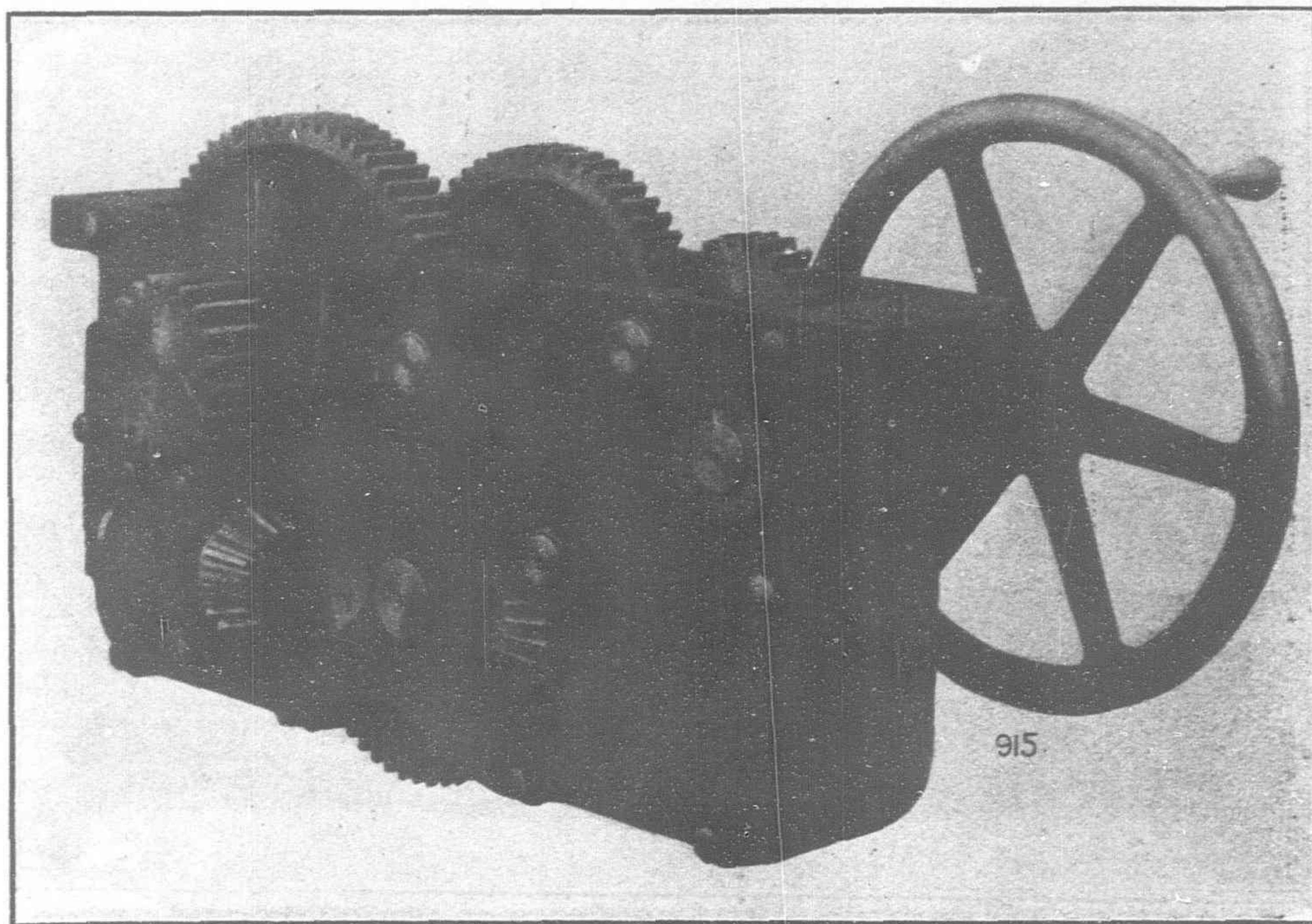
LODGE AND SHIPLEY HEAVY FORGE LATHE.

The lathe shown in the accompanying illustration has been recently designed by The Lodge and Shipley Machine Tool Co. Cincinnati, for the heaviest reductions in rough turning shafting and forgings. How well it accomplishes this may be judged from a recent performance, which is safely within the capacity of the lathe for continuous service, of reducing a .45 carbon steel axle $1\frac{1}{2}$ inches on a diameter with $\frac{7}{64}$ inch feed per revolution at a surface speed of 63 feet per minute. The lathe is unusually massive in all parts so that it will stand up to continued service of the most severe nature.

The actual swing over the carriage is 15 inches and the swing over the bed $30\frac{1}{2}$ inches. The arrangement of spindle speeds is such that the lathe is adapted only for turning work between centers, that is, the speed range suits only diameters which will swing over the carriage. The spindle speeds regularly provide for turning at the rate of not to exceed 140 feet per minute on 3 inch diameters, and of less than 61 feet per minute on 15 inch diameters.

HEADSTOCK.—The headstock as shown is designed to receive a 30 horse power direct current variable speed motor, having a speed range of from 400 to 1200, but any type of motor may be applied and also greater horse power up to 40. There are two gear ratios which with the motor range of 3 to 1 give spindle speeds from 15.6 to 173 revolutions per minute. Any ratio of gearing may be provided to accommodate motors of higher speeds or to give the driving spindle any desired slower speed. The reducing of the spindle speed will of course increase the gear ratio. The driving gears within the headstock are of steel, and are hardened and heat treated. The lightest driving gear is 4 diametral pitch. The front spindle bearing is of large diameter and gives a projected area of 60 square inches. The spindle takes a bearing in standard composition metal replaceable bearings. All other headstock journals are bronze bushed. The back spindle bearing is also of large diameter and gives a projected area of 47 square inches. The machine is provided with a compensating face plate drive. Face plate is 22 inches in diameter and is made of steel, as are the dogs which act as drivers. These drivers can be adjusted radially on the face plate to accommodate driving dogs of various capacities and lengths. The driving shafts within the headstock are supported on both sides of the gears, thus eliminating all overhang. Forced lubrication is provided by pumped oil circulation for all of the driving gears, also for all of the journals, including the main spindle bearing and the thrust at the back of the spindle. The spindle is solid, and runs against a solid hardened steel plug at its back end to oppose the tremendous thrust of the spindle. The oil drains from the headstock bearings and gearing to a reservoir cast in the bed underneath the headstock, and is pumped from this reservoir by a positively spiral geared pump up to a reservoir at the top of the head, from which it is piped to the various bearings and gears. The centers are No. 6 Morse taper, and the one in the headstock is fitted into a hardened steel bushing forced into the spindle. The headstock is 48 inches long over all, and has the necessary gear covers to entirely enclose all the driving gearing. The machine will deliver, with a 30 horse power motor, about 19,500 pounds full at an 8 inch diameter of shaft and with a 30% overload of motor about 25,000 pounds. This would ordinarily create a pressure of 400 pounds per square inch on spindle bearing, but the driving pinion is so placed that the pressure of the cut is opposed by the driving pinion itself, consequently this amount of pressure per square inch is greatly reduced.

TAILSTOCK.—The tailstock arbor is of large diameter and length, and is reamed for No. 6 Morse taper. It is made of tool steel. The tailstock has long bearing on the bed, and a locking pawl engages a rack cast inside the bed. The screw for adjusting the tailstock arbor is



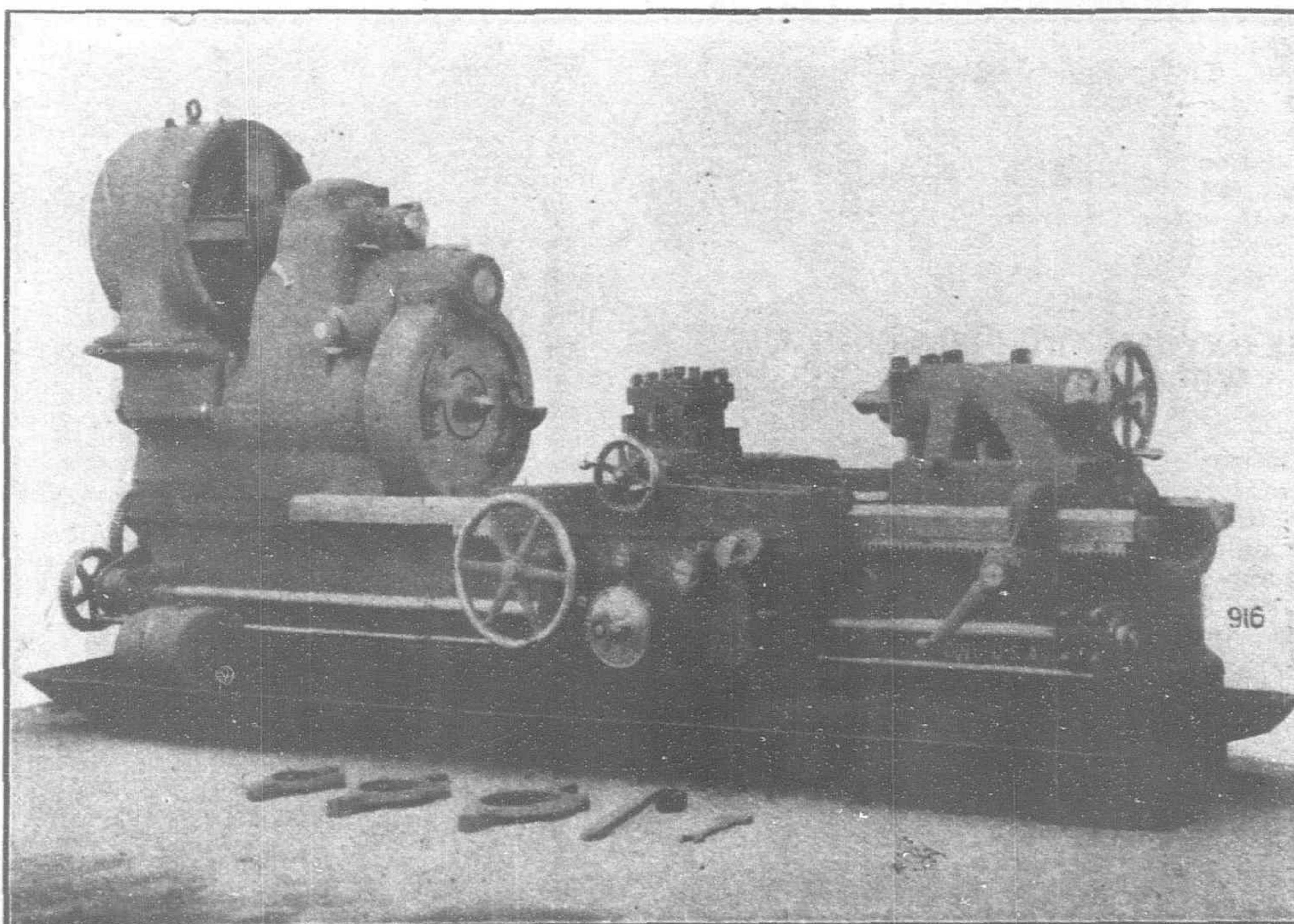
HEAVY FORGE LATHE APRON. REAR VIEW SHOWING COMPLETE BACK PLATE, ALL STEEL GEARS AND CENTRAL OILING STATION

of large diameter, and the total bearing surface of the tailstock on the bed is 120 square inches.

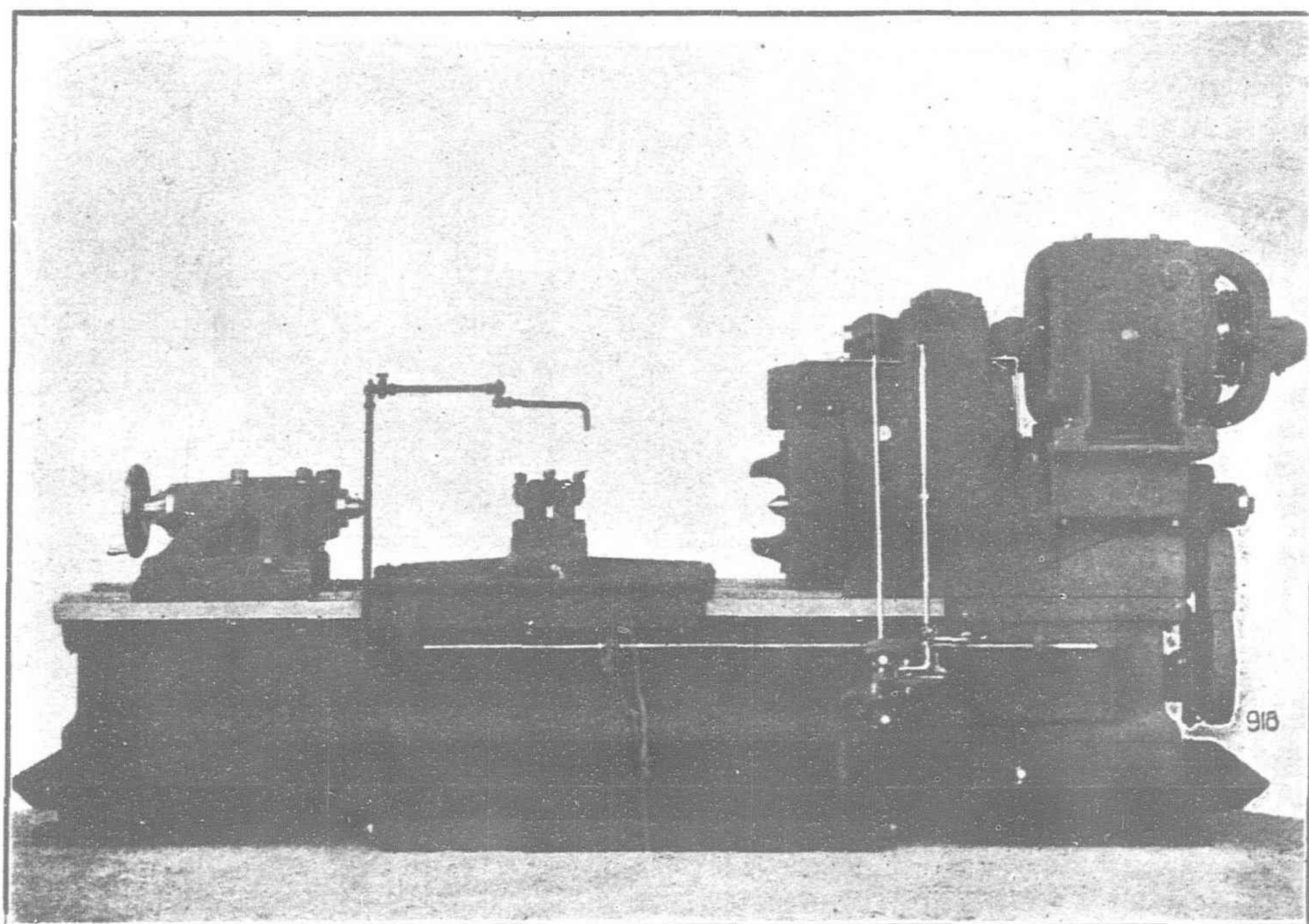
APRON.—The rack pinion is unusually large in diameter and of wide face, and is made of high carbon steel. The smallest gear in the apron is $3\frac{1}{2}$ inches in diameter, and the finest pitch used 5 diametral pitch. The smallest face of any gear in the apron is $1\frac{1}{2}$ inches. All apron gears are steel, and all bearings are bronze bushed. The friction for locking the feed is placed on the outside of the apron to insure close inspection of friction faces at all times. The apron is double webbed, giving support at both ends of all studs. The hand wheel is 18 inches in diameter, and is geared so that one turn moves the carriage about $\frac{7}{8}$ inches.

CARRIAGE.—The carriage is very long and thick. It bears its entire length on the bed, and the total area of bearing surfaces on bed is 245 square inches. It is gibbed both front

and rear, and also under the inside V's. The bridge is extremely wide and strong, and the dove tail is inverted. The tool block is steel, and rests on a cast iron cross slide. It has one center slot to accommodate tools $1\frac{1}{4}$ inches \times $2\frac{1}{2}$ inches, and two open sides for tools of the same dimensions. Serrated and hardened tool steel plates are secured to the block to give the tool a long bearing. The cross slide is very long, and has 168 square inches of bearing surface on the top of the carriage. The cross feedscrew is of large diameter, and is placed as high as possible to resist the action of the cut. There is an oil trough cast entirely around the carriage, and this trough is placed below the inverted dove tail so that the lubricant from the cutting tool will not flood around the sliding surfaces. The carriage drains at the four low corners at its ends back into the drip pan under the bed. The cross feed screw hand wheel is 9 inches in diameter and equipped



HEAVY FORGE LATHE. GENERAL VIEW OF COMPLETE MACHINE



REAR VIEW OF HEAVY FORGE LATHE SHOWING DOUBLE PUMPS, ONE FOR THE LUBRICANT AT THE CUTTING TOOL, THE OTHER FOR OILING THE ENTIRE HEADSTOCK. THIS ILLUSTRATION SHOWS TELESCOPIC TUBING FOR LUBRICANT TO THE CUTTING TOOL.

with two handles. A separate and very substantial pump is provided for the cutting compound, which is geared positively from the headstock, and this pump will deliver a $\frac{3}{4}$ inch stream of lubricant to the cutting tool at the rate of 16 gallons per minute. Instead of the usual flexible tubing there is telescopic tubing, with proper stuffing boxes to take care of the longitudinal traverse of the carriage.

BED.—The bed is very wide at the top and unusually deep. It is mounted on cabinet legs, and has a heavy steel oil pan the entire length. This oil pan does not rest upon the floor, but is sufficiently clear of it to permit a cast iron drip pan mounted upon rollers, to be run under it. The lubricant from the chip pan is drained directly into the cast iron pan mounted upon the rollers, and pumped from this again to the cutting tool. This method separates the chips from the lubricant, and the chip pan itself is always comparatively dry. The front carriage "V" is very wide. The feed rod is of large diameter, and has two key seats diametrically opposite for driving a steel bevel gear in the apron. The rod is driven by plain change gears, and four changes of feed are provided as follows: $\frac{1}{16}$, $\frac{3}{32}$, $\frac{9}{64}$, and $\frac{3}{16}$ inches per revolution. The feed gears are steel, of wide face, and coarse pitch. The controller rod extends along the front of the bed, and is operated by a handle near the top of the carriage.

THE OXYGEN AND DRUM COMPANY'S WORKS AT NAN-MA-TEU SHANGHAI

OBJECTIVE.—The Company's aim in starting these works was to supply a long felt want in the matter of light convenient packages for containing oils and other liquids which would be accepted at low rates of freight and insurance by the Shipping and Insurance Companies. This is made possible owing to the complete absence of leakage ensured by the welding system adopted by the Company in their manufacture.

In order to be in a position to place these drums on the market at a price which will compare favourably with riveted and other drums, the Company have put down their own oxygen making plant. This also enables them to supply pure oxygen for outside purposes, such as the welding and cutting of metals, etc.

Up to the present, the fact that oxygen had to be imported from Europe greatly hampered the

development of this process of welding in the Far East, but it is confidently hoped that now that oxygen and all the necessary apparatus are obtainable in China, the various Dock and Engineering Companies in Shanghai will soon follow the example of those in Hongkong and introduce this system in their works.

DRUM FACTORY.—This part of the building is replete with a range of machine tools for turning out rapidly and efficiently the various sizes of drums manufactured by the Company.

The drums are all welded by the oxy-acetylene system and are guaranteed perfectly tight. They are, for their size, very light and strong, and the body is corrugated with six corrugations which allows the use of comparatively thin metal and makes the finished drum very stiff. They are all fitted with a special type of bung which lies below the chime of the drum and this can be efficiently sealed by the aid of a lead seal, sealing lugs being provided for the purpose.

The following are the weights and capacities of the respective sizes of drums at present manufactured by the Company.

Capacity in Imp. Galls.	Style	Length	Diameter	Weight
24	Plain	30 $\frac{1}{2}$ "	18"	47 lbs.
40	Corrugated	31 $\frac{1}{2}$ "	24 $\frac{1}{8}$ "	63 ..
60	"	33 $\frac{3}{4}$ "	28 $\frac{1}{8}$ "	83 ..
80	"	36"	31 $\frac{1}{8}$ "	112 ..

Owing to their lightness, strength and freedom from leakage they will be accepted at the lowest freight and insurance rates.

The Company are prepared to make other sizes and styles to suit the requirements of their clients, if ordered in sufficient quantities.

OXYGEN PLANT.—The oxygen making plant is designed to make pure oxygen abstracted solely from the atmosphere, and operates on what is known as the "Linde" system.

Besides the welding and cutting of metals, oxygen can also be used for medical purposes, oxy-hydrogen or coal gas lime light apparatus, etc. The Company guarantees the oxygen supplied by them to be over 98% pure, and it leaves the works in cylinders of various sizes to suit the clients requirements.

ACETYLENE PLANT.—The Company also supplies calcium carbide for the manufacture of acetylenes on the users' own premises and for this purpose they have in stock several portable types of generators. They also supply

the gas dissolved in acetone in cylinders for lighting, or for use with oxygen for welding or cutting purposes.

GENERAL.—The factory machinery is driven by two four cycle Diesel engines, one a single cylinder and the other a two cylinder, they both use petroleum residue as fuel. This is about one third the price of kerosene and, the engines use a smaller quantity of this per brake horse power per hour than the very best type of kerosene engine does of kerosene.

ASBESTOS-CEMENT-SLATES

The excellent qualities of this article have already acquired for it high repute and great appreciation throughout the world. The slates are made exclusively from Asbestos and Portland Cement and rank foremost among all building materials on account of their security against fire, their weather-resisting qualities, solidity, lightness, stability of volume, their sound-muffling and insulating capacities and their power of resistance against acidiferous atmosphere and vapours.

Asbestos - Cement - Slates are used for roofing as well as for covering walls and ceilings. They combine all the merits of natural and artificial products used for the same purposes without having their disadvantages and may thus be regarded as an ideal roofing and building material.

Their lightness of weight, incombustibility, waterproof quality and bad heat conducting capacity have secured for Asbestos-Slates a very extensive use for building and fire proof purposes, for insulating electricity, heat and cold. As roofing it has particularly stood the test in an exceedingly satisfactory manner while under the influence of the tropical scorching heat of the sun, displacing natural slates on account of their high prices also tiles or corrugated sheet-iron owing to the serious disadvantages attaching to these.

In recent times Asbestos - Cement - Slates have also frequently come into use for School-Houses, Hospitals, Tropical Buildings, Airship-Halls, Warehouses and Automobile-Garages. In the circumstance it seems opportune to call the special attention of building contractors in this district to the ideal kind of roofing material.

HONGKONG'S BUILDINGS.

JARDINE, MATHESON'S OFFICES.

The Offices of Messrs. Jardine, Matheson and Company constitute one of the distinguishing features of Hongkong's architecture. The British Colony is famed for its fine piles of business houses, and as the years go by it has increasing cause to be proud of the substantial evidence accumulating in the shape of private and public buildings to testify to its prosperity.

Distinguished in its commercial associations with the East the firm of Jardine, Matheson and Company has added to its prestige by the erection of the building illustrated on the opposite page. Situated in the busiest part of Hongkong it stands on the corner of Des Voeux Road and Pedder Street, and faces on the one side the new Post Office, on another the Hotel Mansions and on a third the Hongkong Hotel. It lends distinction to the group.

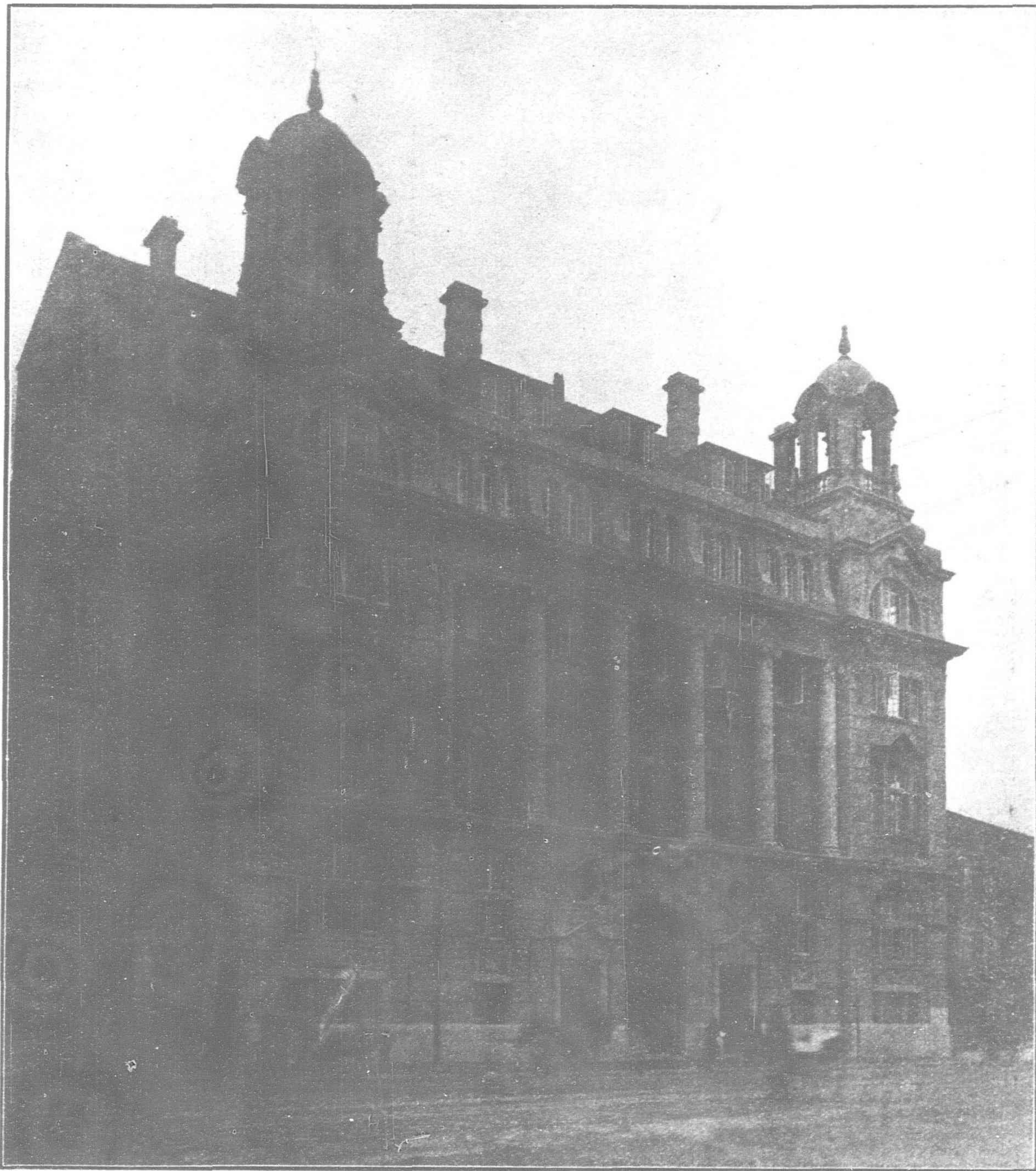
The main walls of the building are faced with Amoy brick on the outside, with cement plaster mouldings. The ground floor verandahs are of dressed granite, the walls above being plastered. The staircase is of granite, the floors of cement concrete and wood blocks, and the roof cement concrete covered with asphalt and flat tiles. Virtually the building is fire proof, the window and door fittings and office furniture and fittings being practically the only inflammable material used. Each floor has its own reinforced concrete fire-proof strong rooms, providing each department of the great business with its own safe custody for books and documents. The business offices are carried out in most modern style with special attention to ventilation and lighting, and the whole constitute a commodious business place of credit to the owners, and the designers,—Messrs. Palmer and Turner, architects,—and an ornament to Hongkong.



THE "EWO" HONG

New Offices of Jardine, Matheson & Co., Ltd., at Hongkong

SHANGHAI'S NEW BUILDINGS



THE SHANGHAI CLUB

THE SHANGHAI CLUB BUILDING

The International Settlement of Shanghai strikes the visitor as a piece of Western metropolitanism dumped down in the East. Its modern buildings would be a credit to any Occidental city, and the Bund sweeping along the Whampoo River presents many striking illustrations of handsome architecture. One of the most imposing additions to the long line of well-designed buildings facing the river is the new Shanghai Club, in a rendering of the English renaissance style. The illustrations given herewith speak for themselves. The façade is carried out in ornamental stone, relieved by Soochow granite columns and plinth, whilst the walls are of concrete reinforced by steel stanchions and beams. The floors are also of reinforced concrete, and in these respects the building is fireproof.

The interior of the Club is sumptuous. A broad flight of granite steps leads to a magnificent hall 90 feet in length, 30 in breadth and 41 feet 6 inches in height. Rising from a

handsomely designed floor of black and white marble are magnificent Ionic columns 17 feet 9 inches high supporting entablatures and arches and surmounted by a heavy dentilled cornice and a baralled ceiling of glass. A balcony runs round the hall at the first-floor level, and is reached by an elegant white Sicilian marble staircase or by lifts, which also communicate with the higher floors containing the bedrooms.

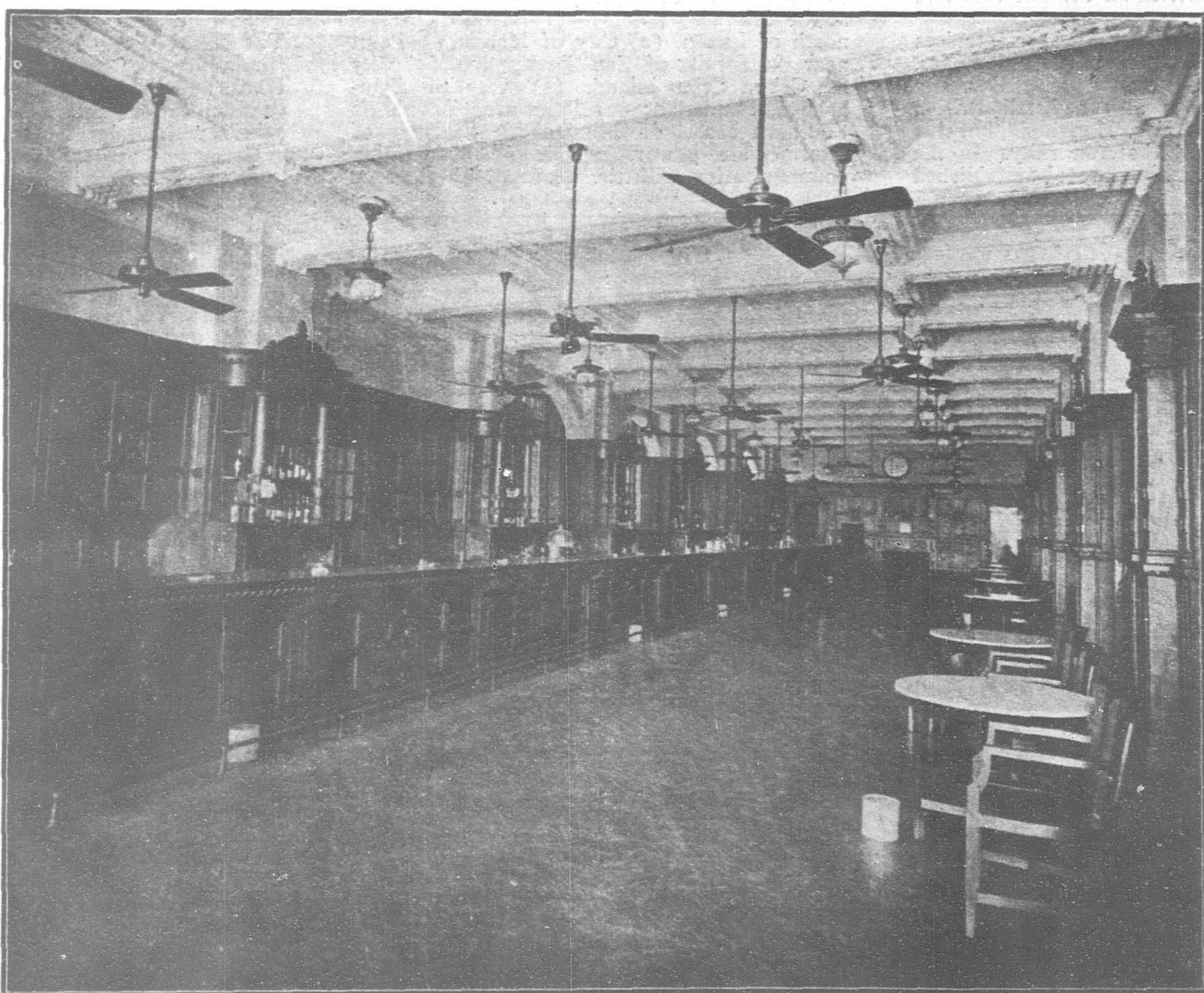
To the south of the main hall is the largest bar in the East, carried out in the Jacobean style, panelled in oak. It is 110 feet 7 inches long and 30 feet wide. On the same floor is a billiard room, oak panelled, with raftered ceiling and leaded windows, the dimensions being 76 feet 6 inches by 29 feet 7 inches, a reading room in the "Adams" style 67 feet 6 inches by 30 feet, and a smoke room 36 feet 3 inches by 39 feet. The dining saloon is on the first floor overlooking the river, and is a magnificent room, 102 feet 4 inches by 43 feet 7 inches. The walls are panelled in a warm red, with teak dado. A large open fireplace at each end of the room is surmounted by a life-sized oil

painting of the late King Edward and Queen Alexandra. There are three other dining rooms in the same floor, as well as the library, reading room, and a second billiard room, 76 feet 6 inches by 29 feet 7 inches, the walls being panelled in oak, the ceiling vaulted and the windows leaded. A card room is nearly. On the second and third floors are situated the bedrooms, there being 40, each being provided with bathroom and shower, on the fourth floor are the kitchen, sculleries and service rooms, all the walls being tiled. Rooms for the stewards and servants are on the same floor. Five electric lifts run between the service room and the dining room.

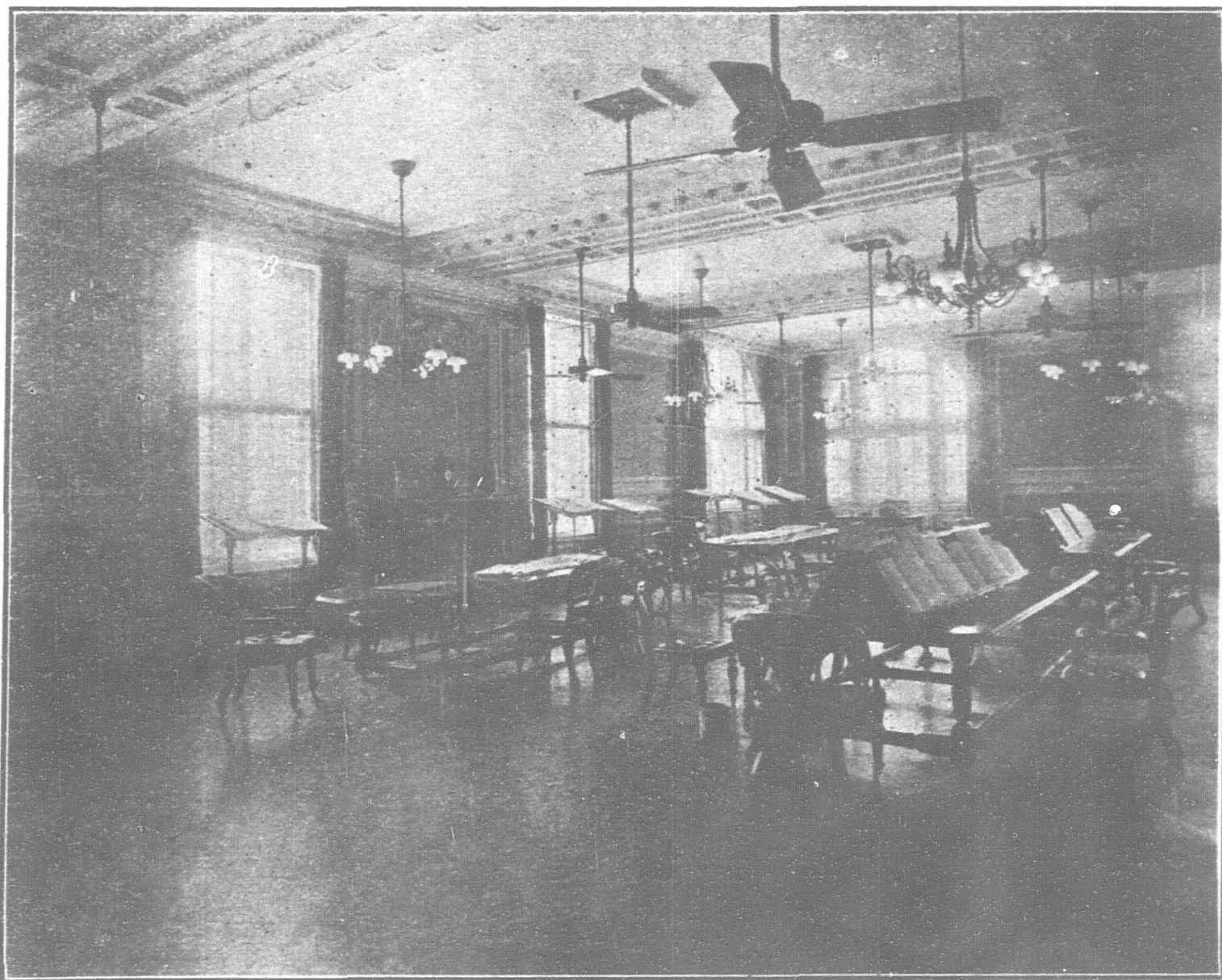
The building was designed by the late Mr. B. H. Tarrant, whose plans were accepted as the result of an open competition. Mr. A. G. Bray, upon the death of Mr. Tarrant, carried on the work for the firm of Tarrant and Morriss architects, and was responsible for the interior design and general completion of the building. The construction was in the hands of Messrs. Howarth, Erskine, Ltd.



THE SHANGHAI CLUB—DINING ROOM



THE SHANGHAI CLUB—THE BAR



THE SHANGHAI CLUB—READING ROOM

WIRELESS IN THE FAR EAST

There seems to be good reason to anticipate that the whole of the Far East will shortly be linked up by wireless. More attention is being given to this important subject than ever before and if proposals which are now under consideration bear practical fruit the day is not far distant when the Far East will be in touch with America on the one side and Europe on the other.

At the present time there are services operated by the Government of the Philippines, Japan, Netherlands-India, Russia, Germany and China. There is also a small British station at Cape D'Aguilar, Hongkong, but this is used exclusively by the Admiralty. In the near future, however, stations are to be established

at Singapore and Hongkong. In the Philippines the usefulness of wireless was early recognised and in February last year the Philippines Wireless Board submitted recommendations relating to the institution and maintenance of a system of wireless telegraphy in the Philippine Islands. The Board recommended the establishment of fourteen wireless stations. Of these six were to be stations of high power to be erected at the following points:—(1) Island of Batan, north of Luzon, (2) City of Manila, (3) Point near the Straits of San Bernardino, (4) City of Cebu, Cebu Island, (5) City of Zamboanga, Mindanao; (6) Point near Davao, on Southern coast of Mindanao. Stations of intermediate power, capable of maintaining communication with the nearest high-powered

station, it was recommended should be established at Baguio, Luzon; Tacloban, Layte; Iloilo, Panay; Cuyo, Cuyo Island; Puerto Princesa, Palawan Island; Dapitan, Mindanao; Malabang, Mindanao; and Jolo, Jolo Island. In addition the Board recommended that at some future time low power stations capable of maintaining communication with the nearest established station, be installed at twenty-eight other points. An appropriation of P30,000 was recently authorised for the reconstruction and repair of the wireless stations in Mindanao. At Zamboanga P15,000 is to be expended, P4,000 for the erection of a new station, P2,500 for employees' quarters, P1,000 for a new antenna, insulation, etc., P4,000 for a new generator, P2,000 for a new transformers, and P1,500 for new instruments, switchboard, etc. The Philippines Commission has appropriated P145,000 for wireless telegraph stations in the non-Christian provinces. These stations are for the use of the Insular Government and the army and navy. The money will not be spent, however, until a similar sum has been appropriated by the United States Congress. Trans-Pacific facilities are also contemplated. The Western Union has announced that it has entered into a traffic agreement with the Marconi company, which provides for the extension of the Marconi system from the Pacific Coast of the United States to Hawaii, China, Japan and the Philippines.

The Japanese Government has stations at Osi Saka, Gota Island; Tailienwan, Port Arthur; Keelung, Formosa; Nagasaki, Sasebo, Choshi, Shimonoseki, Tsunoshima and Otchishi. Some of these stations take naval messages only.

The Netherlands-India Government has stations at Sabang, Sitoebondo, Balik Papan and Timor Koepang, while a fifth is in course of erection at Amboina. The first named has a range of 1,000 miles and is thus within reach of Colombo and Singapore.

Russia has two stations at Vladivostok. Though for ordinary purposes northern and western Siberia would not be considered to be within the geographical limits of the Far East, yet wireless laughs at map-makers and Russia's wireless intentions in this regard have their interest for this part of the world. The Duma is to be asked to provide \$515,000 for building radiotelegraph stations along the Kara and White seas to secure telegraphic communications between northern and western Siberia with western Europe via the Arctic Ocean.

Germany has stations at Tsingtau and at Angaur and Yap in the Caroline Islands.

China has a commercial station at Shanghai and small Government stations at Peking, Tientsin, Paotingfu, Hoihow, Chuwen, Canton and Kowloon. It is stated that it is proposed to link up Peking and Lhasa, with repeating stations at Tachienlu and Batagg. A coastwise system of twelve stations from Hainan to the Gulf of Pechihli has also been mentioned. An excellent Open Letter addressed by the writer who employs the pen-name "Putnam Weale" to the Government of China, deserves to be noticed. Mr. Putnam Weale, after commending the Minister for Communications for reducing the domestic telegraph rates, points out that the adoption by China, as a business undertaking, of the Marconi wireless system is the only possible means of modifying the present state of affairs which effectively isolates China from close daily contact with the rest of the world. It seemed certain that very shortly India would be in direct communication through a chain of stations with England. China had now a unique opportunity. Her territory extended to within 205 miles of the Afghan frontier. If she established powerful stations on her extreme Western frontier she would be able to link up with Europe. Mr. Putnam Weale suggests that the Marconi Company should have official approval to organize a subsidiary Chinese Company to construct and equip stations, which would be taken over by the Central Government when they were in working order. This suggestion stands out from among the hundreds with which the Peking Government is being inundated as eminently worthy of sympathetic consideration. Should it be adopted it will result in great material and moral benefit to China.



THE SHANGHAI CLUB—DOMINO ROOM

COPRA IN THE PHILIPPINES.

When it is noted that 120,000 tons of copra are exported from the Philippines annually it will be realized that this trade is one that deserves all the fostering care that can be given to it by the Government. The price paid for Manila copra is £23.17.6 per ton, while that realized for Malabar copra, which is considered the best in the world's market, is £26, c.i.f. continent. The Bureau of Agriculture has now under consideration the means of improving the Manila product so that it may command a price equal to that realized by Malabar copra.

The difficulty is that the kiln-drying process, which obtains in the Philippines, ruins the copra. It becomes permeated with smoke, and an odour and taste is left that cannot be eliminated by refining. The copra is poorly dried, except the Cebu product which is dried by the sun. The rest remains damp and the dampness causes the formation of black mould which eats away the oil and also tends to make it harsh and sour. Naturally the value of the oil and coconut oil cakes is reduced. There is also a loss in transit from deterioration, which is also due to improper drying. Mr. O. P. Barrett, chief of the experimental stations of the Bureau of Agriculture, holds that no time should be lost in standardizing their output so that the buyers will be able to count upon getting A1 material from them throughout the year. He points out that in several other countries, notably in Samoa, and to it a slight but increasing extent in Ceylon, the great advantage of driers is now recognized. It was a deplorable commentary on the progressiveness of the Filipino agriculturists that in the greatest copra producing country in the world there were no copra driers which were turning out a smokeless article suitable for the higher grade copra products. One rotary drier had, however, been recently ordered from Europe and several producers and dealers were now discussing the advisability of setting up modern drying apparatus. The steam or hot-water system, Mr. Barrett thinks, would have considerable advantage over the hot-air-pipe system because in the former case the copra could not be burned through carelessness or accident. The fuel in either case would be husks and shells and the running expenses of such a plant would practically be only the labour employed in charging and emptying the trays of the oven.

There seems every prospect of this important matter being seriously taken up by the Bureau and consequently there is an excellent prospect of Manila copra ranging up alongside of the Malabar product in quality and price.

MANILA AS A PORT.

The many excellencies of Manila as a port are known to those who have had the good fortune to visit the capital of the Philippines, but it has taken the steamship companies some time to develop a just appreciation of its possibilities. The fine steamers of the Pacific Mail Company, it is true, have long been callers at the port, and the Australian liners are regular visitors. There is also the local line between Hongkong and Manila, which comparatively recently passed under the American flag. But it was left for the Norddeutscher Lloyd to discover that Manila was "worth while" as a port of call for European liners. The energetic officials of the Nippon Yusen Kaisha have also under consideration a proposal for their steamers on the European run to call at Manila. One of the leading officials of the Nippon Yusen Kaisha recently visited Manila for the purpose of discussing the proposal with Messrs. Warner Barnes & Company, the agents of the N.Y.K. at Manila. Though no definite decision has yet been arrived at it is understood that the plan is regarded favorably and that there is a possibility that at the beginning of next year the N.Y.K. boats on the European run will make Manila a regular port of call. A considerable amount of cargo, both to and from Europe, is transshipped at Hongkong and it is thought that the new departure



THE SHANGHAI CLUB—CARD ROOM

would prove profitable, more especially as the passenger traffic via Suez is growing rapidly. These proposals are an additional proof that those who in darker days prophesied that Manila had excellent prospects of developing into the premier port of the Far East, had good reason for their confidence.

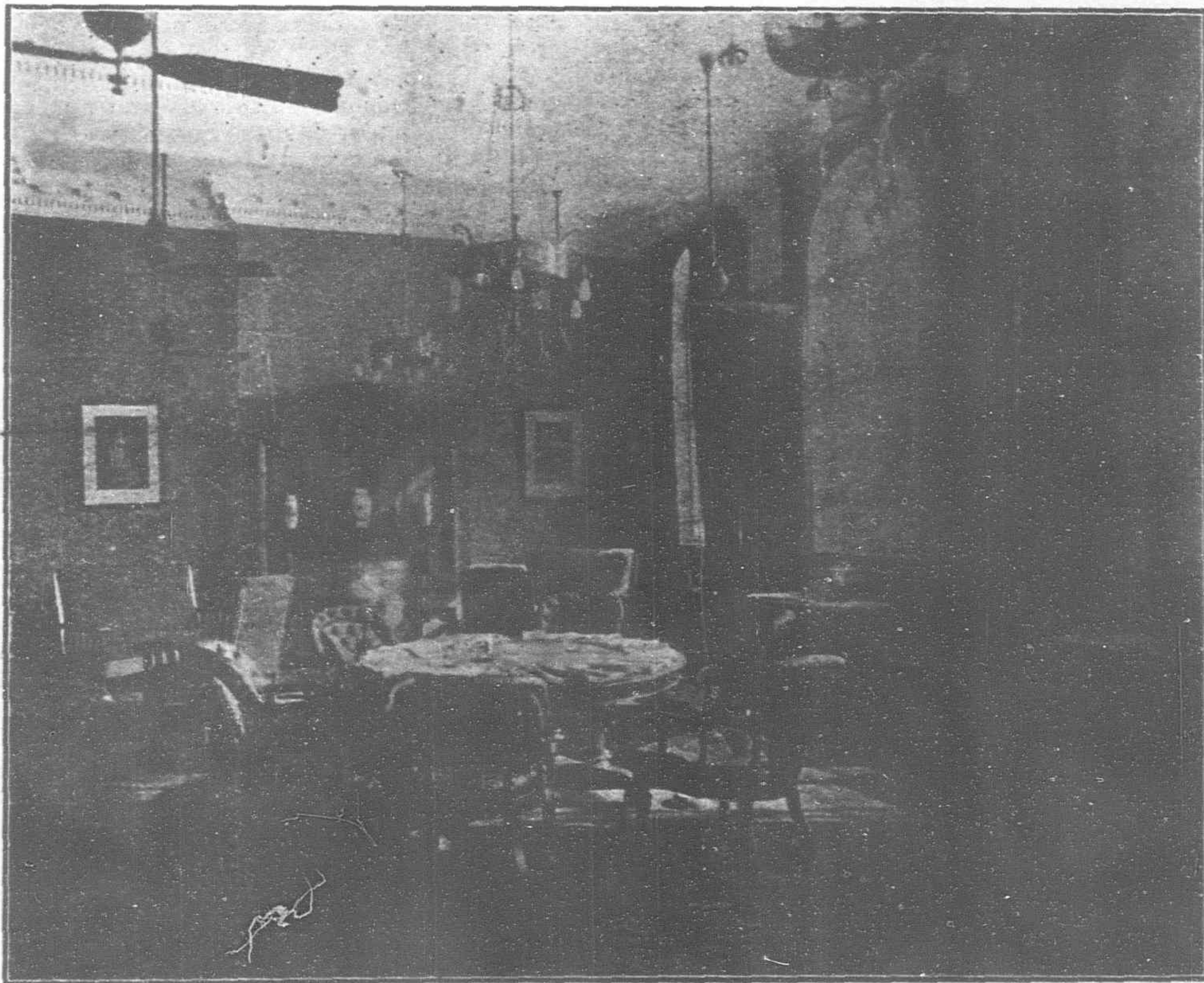
RUSSO-ASIATIC BANK

In accordance with a resolution passed at the General Meeting of Shareholders of the

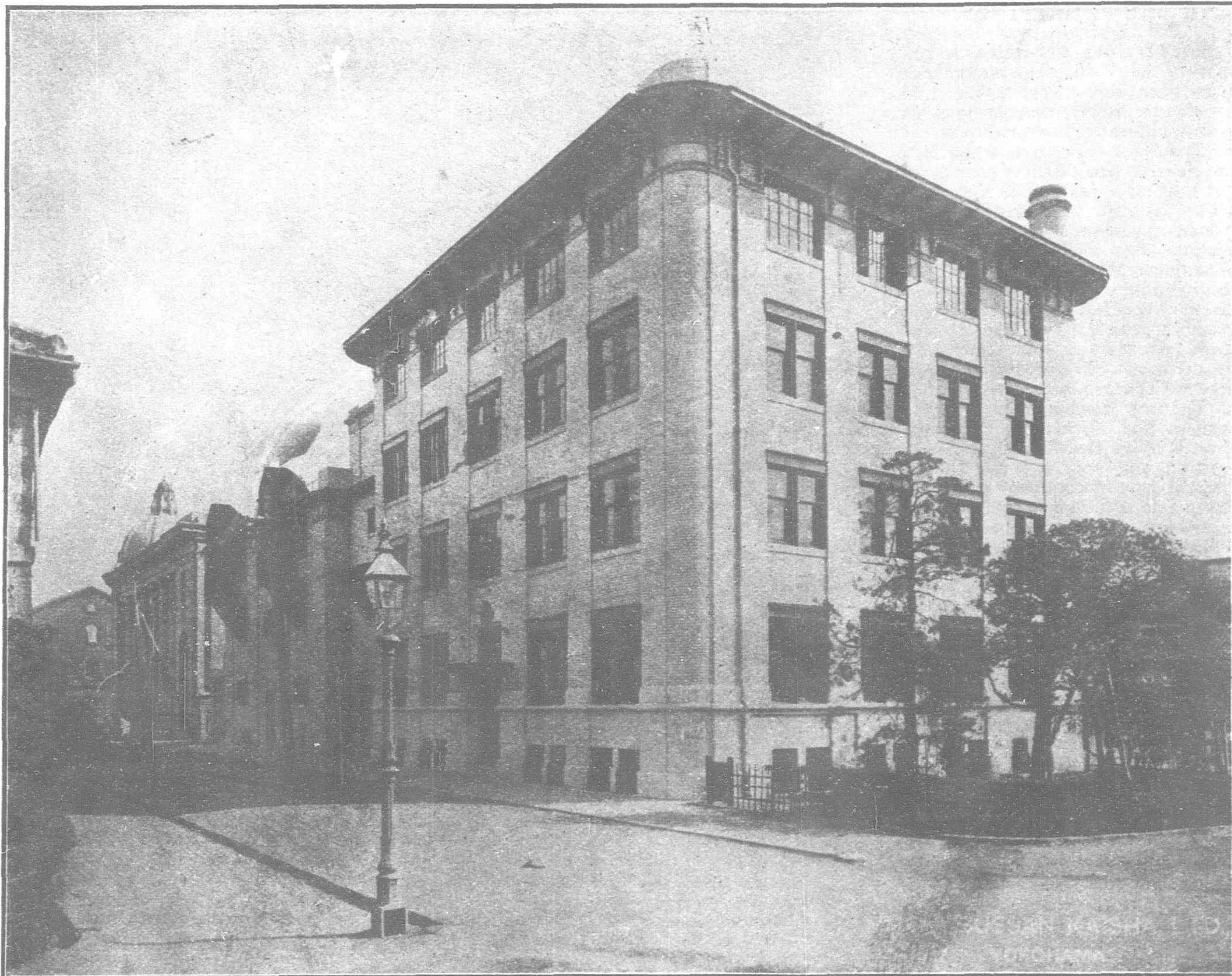
Russo-Asiatic Bank held in St. Petersburg in March 1912, the Russo-Asiatic Bank has offered, for subscription, 55,333 shares of Rbs. 187.50, face value, at the price of Rbs. 281.25.—These shares will participate in the profits of the whole year of 1912.

40,000 shares were reserved by preference to actual share-holders, in the proportion of 3 new shares to every 14 old shares.

13,333 shares were reserved by preference to holders of Founders Certificates of the Russo-Chinese Bank.



THE SHANGHAI CLUB—LIBRARY READING ROOM



THE NEW OFFICE BUILDING OF THE MITSUI BUSSAN KAISHA, LTD., AT YOKOHAMA

THE MITSUI BUILDING, YOKOHAMA.

One of the latest buildings about which Yokohama can boast is the substantial and commodious office of the Mitsui Bussan Kaisha, situated next door to the Chartered Bank. Whilst not ornate from an architectural point of view it is imposing and particularly suitable to the requirements of the progressive firm for whom it was built. It is constructed of steel and concrete, the outside finish being of granite and glazed bricks, whilst the interior has been handsomely carried out in Nara wood, glazed tiles, and moulded ceilings. The rooms are lofty, well lighted, and ventilated, and the whole building is steam heated. Mr. Endo Oto was the architect.

A NEW HOLT STEAMER

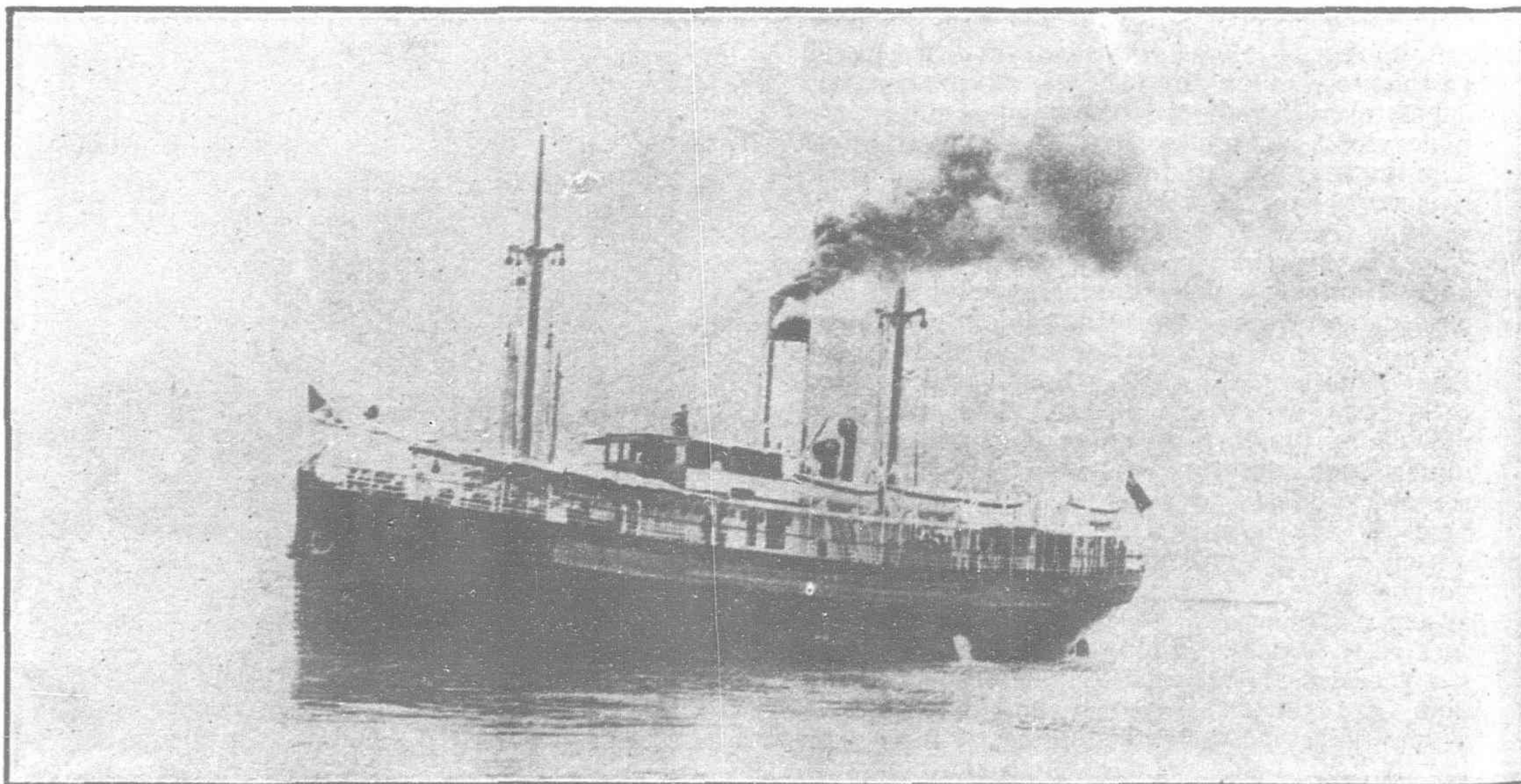
BUILT IN THE TAIKOO DOCKYARD

The last addition to Messrs. Alfred Holt & Co.'s fleet of steamers is the Circe, which has been built by The Taikoo Dockyard & Engineering Co. of Hongkong, Ltd. The Circe is a finely modelled steel screw steamer 204 feet over-all by 31'-6" beam and 21'-6" deep to awning deck. Built to Board of Trade requirements for a passenger steamer, the vessel has been specially designed to meet the requirements of the Singapore-Deli trade. The 'tween deck gives a large space for the carrying of deck passengers, being well ventilated with openings in the sides of the vessel, and is also arranged for the carriage of horses. On the awning deck the saloon is in a midship deckhouse, on each side of which are several staterooms, all fitted up with the latest improvements and handsomely finished. The officers and engineers are accommodated aft in

a steel deckhouse, the rooms being specially large and airy. The master's room is on the bridge deck, with chart room in front. The crew and petty officers are housed on the main deck.

The Circe is well equipped with life-saving gear, five large teak lifeboats and one cutter being fitted under davits. Steam steering gear is fitted in the engine casing, and a powerful steam windlass and stockless anchors have also

been provided. The vessel is fitted with electric light throughout. The machinery consists of one set of triple-expansion, surface-condensing engines, steam being supplied from a single-ended boiler having a working pressure of 185 lbs. per square inch. A Cochran type donkey boiler is also installed for auxiliary purposes. On trial the vessel showed herself capable of maintaining a mean speed of 11½ knots per hour.



"S.S. CIRCE," BUILT BY THE TAIKOO DOCKYARD & ENGINEERING COMPANY, OF HONGKONG, TO THE ORDER OF MESSRS. ALFRED HOLT & CO.

COCONUT GROWING IN THE PHILIPPINES

By the Hon. DEAN C. WORCESTER, Secretary of the Interior, Philippine Government

GENERAL STATEMENT.

After fifteen years of observation on the ground in the Philippines, I have reached the conclusion that no branch of agriculture there offers such certainty of steady and assured returns from comparatively small investment as does the growing of coconuts, which may be raised to advantage as far north as Pangasinan, La Union and South and North Ilocos, and flourish in the Southern Philippines to a degree nowhere excelled and seldom equaled in other countries.

I have found it extremely difficult to obtain really reliable information as to cost of production and average annual value of crop. As a rule the Filipino has the vaguest ideas on these subjects; one man will tell you that his trees average ten nuts per year, while another will solemnly assure you that fairly good trees produce three or four hundred. The same lack of accurate knowledge is encountered when one endeavours to ascertain the cost of planting catch crops among the young trees and the presumable profits to be derived therefrom. It has, therefore, taken a very long time to gather the information which follows, but I believe that it is reasonably reliable and that the conclusions which I draw from it are conservative.

THE SELECTION OF SITES FOR COCONUT PLANTATIONS.

Soil and climatic conditions in many parts of the Philippines are ideal for coconut production. It should be remembered that the agricultural methods of the natives have violated every known rule. Seldom has the ground been really properly prepared for planting. The trees invariably stand too thickly. The Filipino cannot rid himself of the idea that the more seed he sows the greater will be his harvest. This theory, when applied to coconuts, results in the production of tall, spindling trees, producing half the number of leaves they ought to have, and bearing nuts sparingly, if at all. It is a marked case of a hard struggle for existence and the trees which lose out are often barren for years before they ultimately die, yet it is usually impossible to convince the owner of a plantation which is suffering from too close planting that he would be much better off were he to cut down half or two-thirds of his trees, selecting for elimination those which produce few or no nuts.

On the existing plantations trees frequently stand within ten feet of each other, or less,



COCONUT TREE IN FRUIT
SAN RAMON FARM, MINDANAO, P.I.

whereas thirty feet should be the minimum distance from tree to tree. As a rule, little effort is made to keep the ground under the trees free from brush after they reach the

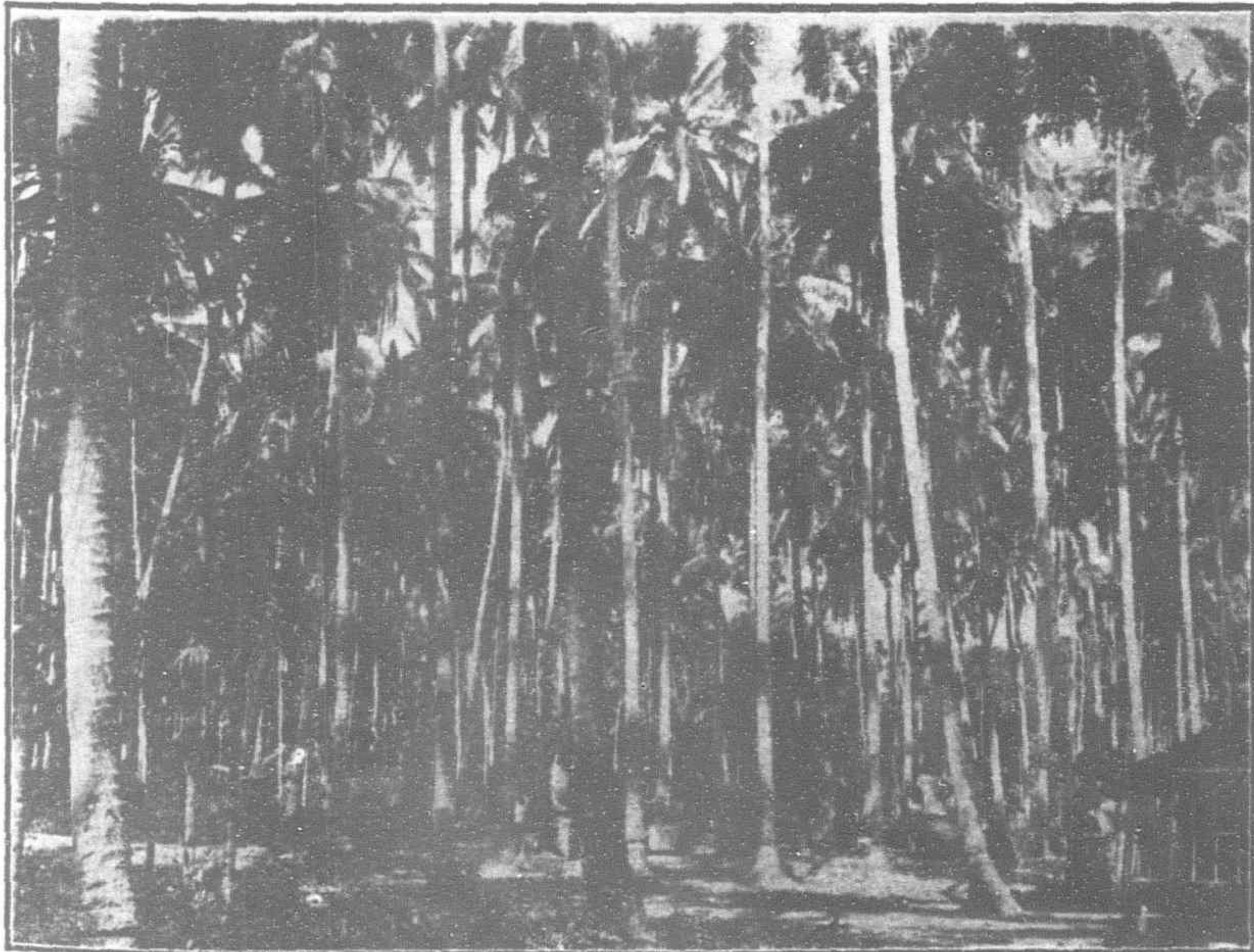
producing age, and it is by no means unusual to find forest trees competing successfully with coconut palms for light and air. Dead leaves are not removed, but are allowed to hang until they fall, and then slowly to rot on the ground. No effort is made to stop the depredations of the rhinoceros beetle, which in some regions is fairly abundant. In order to facilitate climbing, notches are carelessly cut into the bark of tender trees, often extending through into the wood. Wherever the lower surface of such a notch slants inward, water stands in it and this causes rotting of the wood. The vast majority of native coconut plantations suffer severely and needlessly from this cause. If those who gather the nuts were provided with the climbers used by linemen in ascending telegraph poles, they could go up and down the trees easily and safely without doing them the slightest injury. If notches must be cut, they should at least have their lower surfaces inclined downward and outward so that water will not stand in them, and great care should be taken not to cut through the bark.

The present owners of coconut groves often neglect to harvest their nuts, which are allowed to fall and lie around on the ground. It is seldom indeed that effective means are taken to check the depredations of fruit bats, crows and monkeys, or to disturb the rats which not infrequently nest at the bases of the leaves and help themselves to the fruit.

There are many very extensive plantations which produce no nuts at all for the reason that their owners prefer to tap the blossom stalk and make from the juice thus obtained a fermented drink known as "tuba."

Only in the rarest instances is any attention paid to seed selection, yet in spite of this carelessness and neglect the Philippine Islands produced during the fiscal year ended June 30, 1909, some 1,658,724 piculs, or approximately 231,787,050 pounds of copra, or dried coconut meat. This output excels that of Java, of the Straits Settlements, of Ceylon, or of the South Sea Islands, and places the Philippines at the head of the list of coconut growing countries. In fact, during the year mentioned the Philippines produced about one-third of the world's output.

A large amount of copra is consumed locally. During the year in question 232,728,116 pounds of copra, valued at \$6,650,740, and 364,788 gallons of coconut oil, valued at \$157,916, were exported. If this result has been obtained under the haphazard methods in vogue what



COCONUT GROVE, MANGALDAN, PANGASINAN, P.I.



DRYING COCONUT MEAT IN THE SUN, SAN RAMON FARM



COCONUT RAFTS IN PANGASINAN, P.I.

may be anticipated when due care is exercised in selecting suitable land, when it is properly cleared and planted, and when suitable cultivation is continued while the young trees are growing and after they begin to produce?

Soil and climatic conditions vary greatly in different parts of the Philippines and it is important in selecting a site for a plantation to know what to seek and what to avoid. Most authorities are agreed that a stiff, clayey soil is not favourable to coconut production, but I have seen perfect trees, bearing 100 or more splendid nuts each, growing in precisely this kind of soil. It is, of course, possible that there may have been an underlying layer of more friable and permeable soil, but the existence of these magnificent trees growing in clay conclusively demonstrates the fact that it is unsafe to conclude, from apparently unfavourable surface indications, that a given piece of land may not produce coconuts to great advantage.

Other authorities inveigh against a very sandy soil as being unsuited to coconut growing, and go so far as to state that every grain of sand in excess of what is required to make the soil fairly permeable to water is a positive detriment, yet the finest coconut trees that I have ever seen stood in pure beach sand, so poor that it would hardly grow either grass or weeds, and so destitute of plant-food that a careful chemical analysis failed to reveal the presence of any at all!

Trees growing in sand close to the sea naturally never lack for water, and all authorities are agreed that coconut trees need an abundant supply of water at all times. It is equally certain that they are prejudiced by the presence, in their immediate vicinity of stagnant water, while in cases where the permanent water-table comes very near the surface of the ground their roots spread out just above it with the result that they fail to grasp the earth firmly and the trees are readily blown down by violent winds.

The saying so common among natives of coconut-producing countries that the trees will not flourish unless they can see or hear the waves of the ocean undoubtedly rests on a solid basis of fact. The greater the volume of water which daily flows up through the stem of the tree and evaporates from its leaves, the more rapid and vigorous the growth of the tree and the greater its productivity. Evaporation being intimately associated with the free circulation of air, it follows that sites which are fully exposed to the prevailing winds are best, unless those winds are so violent as to injure the leaves and dislodge the young nuts. Coconuts should, therefore, never be planted in inclosed and sheltered valleys, but the site

selected for a plantation should be along the coast or on some open plain where the circulation of air will be impeded as little as possible. Regions which have especially well-marked wet and dry seasons are not favourable to coconut production, especially if the dry season be of long duration. While coconut trees are seldom killed by such droughts as occur in the Philippines, the production of nuts is often temporarily checked by drought in provinces where the dry season is especially long and severe.

There are regions in the Philippines where rain usually falls during every month of the year and they are especially favourable for coconut production. Rain maps of the Philippines, showing for each month of the year the rainfall conditions throughout the Archipelago, so far as they are known, may be seen at the Manila Observatory and information relative to the distribution and amount of rainfall in any particular region will be gladly furnished, if available, by Father José Algue, the Director of the Weather Bureau. It will be found that there are many regions where conditions as regards rainfall leave nothing to be desired.

While the coconut palm is admirably adapted by nature to resist severe wind storms and when standing in suitable ground is seldom uprooted by the most violent gales, severe typhoons will sometimes blow all of the nuts off trees, at the same time destroying the blossoms so that the resumption of fruiting will be delayed for a considerable period, while the violent whipping about to which the leaves are subjected in these very severe storms injures them even if it does not serve to detach them from the trees.

While typhoons do not prevent the profitable growing of coconuts throughout the Islands, there are extensive regions in Mindanao, Palawan, and the intervening southern islands where these storms are practically unknown, and it is well, in selecting a site for a plantation, to eliminate possible loss from this source by first studying the storm maps of the Philippines and selecting a region where typhoons seldom if ever occur.

In considering soil conditions, one should remember the old saying that *the proof of the pudding is in the eating*. Owing to the haphazard cultivation methods which have been followed, adult trees, demonstrating fully the capabilities of the soil to produce coconuts without cultivation, may be found in the vicinity of almost any available tract of land, and it is safer to consider facts than to be swayed by theories. However, it can be stated with entire certainty that soil conditions on the numerous flat-topped coral islands rising only ten or fifteen feet above sea level are most satisfactory.

On such islands the permanent water-table lies near enough the surface of the ground so that the roots of coconut trees readily reach it, and the possibility of harm from drought is completely eliminated. The soil is so poor in the food required by ordinary plants and weeds that comparatively little cultivation is required to keep it clean. Mosquitoes do not exist on such islands as there is no opportunity for them to breed, and in general health conditions are ideal. Proximity to the sea insures that free circulation of air which is essential, and incidentally the complete absence of wild hogs does away with the necessity for fencing. The majority of those islands are uninhabited and the absence of human thieves is a factor of no small importance.

Insect pests which are sometimes to be feared on the mainland of the larger islands are also conspicuous by their absence, as are monkeys.

COST OF LAND AND AMOUNT OF SUITABLE LAND AVAILABLE FOR COCONUT GROWING.

It is sometimes possible to purchase from private persons land suitable for coconut growing, but it will usually be found more advantageous to purchase or lease from the Government. Under the provisions of existing law, an individual may not purchase more than 16 hectares (40 acres) of public land. A corporation may purchase 1,024 hectares (2,500 acres) but if authorized to engage in agriculture must, by its charter, be limited to the ownership and control of this amount of land, and persons who are members of a corporation authorized to engage in agriculture may not be members of any other corporation so authorized. The minimum price at which public land may be sold is 10 pesos per hectare (\$2.00 per acre). In selling wild public land it is the custom of the Insular Government to charge the minimum price. Actual title to the land may not pass until after five years of occupation and cultivation. Payment may be made as follows: twenty-five per centum at the time the bid is submitted; the balance upon the making of the award; or it may be paid in one instalment at the expiration of five years from the date of the award. Sums remaining unpaid after the date of the award bear interest at the rate of six per centum per annum from such date until paid.

The provisions as to leasing are more satisfactory. Either an individual or a corporation may lease not to exceed 1,024 hectares (2,500 acres). Leases run for 25 years with the right of renewal for an additional 25 years. The rental during the first period of 25 years may not be less than 10 cents per acre per year, and during the second period of 25 years it may not be more than 30 cents per acre per year. The rental is payable annually in advance.

There are in the Philippine Islands very extensive areas of unoccupied unclaimed public land suitable for coconut growing. Such land is especially abundant in Mindoro, Mindanao, Palawan, and the small islands adjacent to Palawan. Some of the latter offer very many advantages, such as the lack of necessity for fencing against wild hogs; the absence of monkeys; the absence of undesirable human neighbours; freedom from insect pests; free access to all winds; a permeable soil especially suited for coconut growing and the presence of the permanent water-table near enough the surface of the ground to make it certain that there will be no harmful results from drought after the trees are once well established.

The chief drawbacks are isolation and the absence of fresh water, which is lacking on the smaller islands. Rain water, sufficient for all domestic purposes, may, however, readily be caught. These islands vary greatly in size. A number of them have been ordered surveyed in connection with work necessary in surveying for several lease applications, and information as to their whereabouts and extent, and as to the whereabouts of land suitable for coconut growing on the larger islands above referred to, will be gladly given by the Director of Lands, or by the Secretary of the Interior.

TAXES.

In the provinces organized under the regular provincial government act, taxes on land and improvements thereon (by "improvements" are meant *buildings*, not growing crops or coconut trees) may not exceed seven-eighths of one per centum per annum, on what is estimated to be the true sale value of the property. In the provinces organized under the special provincial government act, namely the Mountain Province and Nueva Vizcaya in Northern Luzon, Mindoro, Palawan, and Agusan Province in the Island of Mindanao, taxes are one-half of one per centum per annum on the value of all real estate and personal property in excess of \$100.00. In the latter provinces, therefore, coconut trees are taxable. They are usually appraised at \$0.50 to \$1.00 each. In the Moro Province the taxes are three-fourths of one per centum per annum on the value of all personal property, and real estate, including improvements thereon. Re-valuations are made once in five years.

It is needless to say that the above remarks apply only to land which is actually owned by individuals and to the improvements thereon. Land which is rented from the Government is not subject to taxation, but the improvements on it are.

COST OF CLEARING FOREST AND BRUSH LAND.

The net cost of clearing forest land (by clearing is meant leaving it ready for planting) will obviously vary with the character of the forest, which may be such as to involve a larger or smaller amount of work in felling and burning trees, stumping, etc., and may give a larger or smaller return from merchantable timber and fire wood. The following figures are given by Mr. C. H. Lamb, Superintendent of the Iwahig Penal Colony, and are based on large experience. Mr. Lamb keeps strict account of all labour employed and charges it up at a daily wage of \$0.25.

Felling trees, up to \$4.00 per acre.

Cutting up trees and burning them, \$2.00 to \$16.00.

Stumping, \$2.00 to \$30.00.

First plowing, \$0.60 to \$2.00.

Mr. Lamb gives the following as a safe and conservative estimate of the average cost of clearing one acre of land:

Felling trees	\$1.00
Cutting and burning.....	4.00
Stumping	8.00
Plowing	2.80

• Total.....\$15.80

per acre. Under the most favourable conditions the minimum cost is estimated by him at \$5.60 per acre.

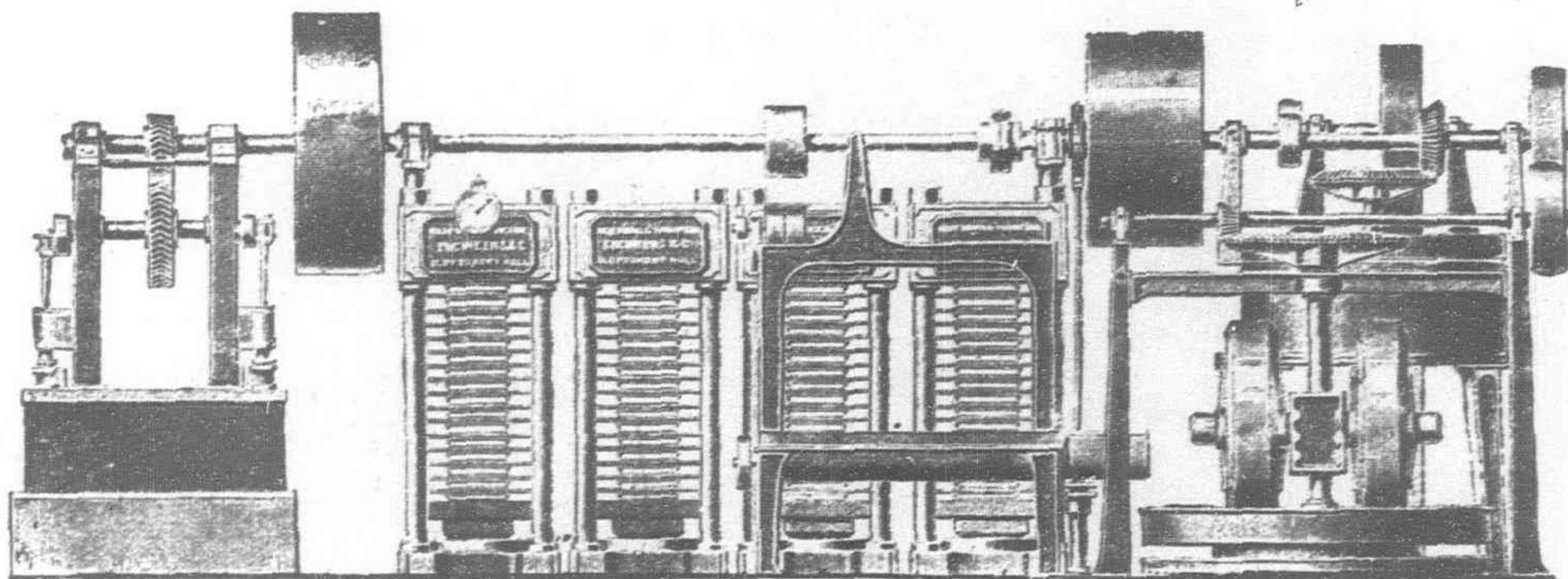
The above sums represent gross expenditure. In some kinds of forest considerable returns may be expected. In Palawan, for instance, Mr. Lamb states that from 10 to 100 logs of good timber, which will net from \$20.00 to \$200.00, can ordinarily be had from a hectare of land, so that on such land there may be an actual profit from the timber cut, and the net cost should not exceed \$8.00 per acre.

The following information relative to the clearing of forest land was given by Mr. J. H. Shipley, Manager of the Mindanao Estates Company plantation at Davao; one man can clear .05 of an acre per day of 12 hours, or an acre in 20 days. At \$0.25 per day this would make the cost of clearing an acre \$5.00.

Mr. Frederick Lewis, formerly in charge of a hemp plantation in Davao, now Lieutenant-Governor of the Subprovince of Bukidnon, estimates the gross cost of clearing forest land at \$15.00 per acre.

Governor Monreal of Sorsogon stated that 30 men would clear 250 hectares of land in a year. Estimating the number of working days at 300 and the daily wage at \$0.25, this would make the cost of clearing that amount of land \$2,250.00, which is equivalent to \$3.60 per acre.

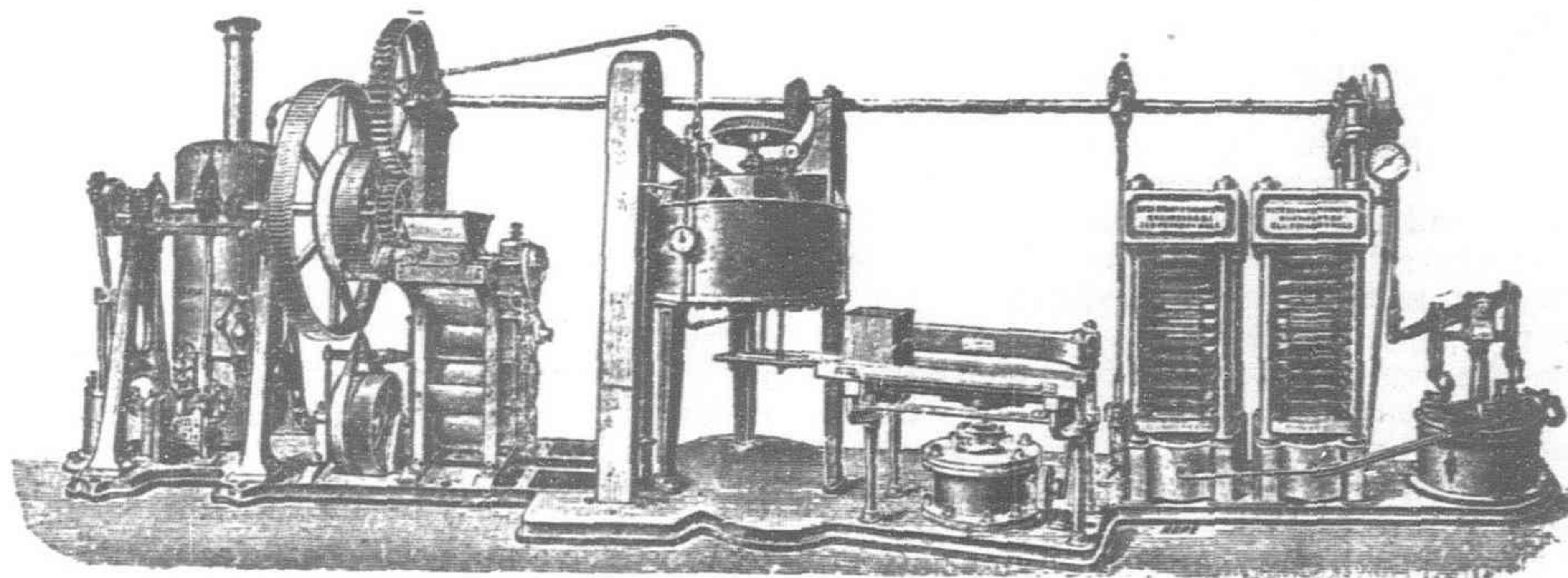
Mr. Cadwallader of the Cadwallader Lumber Company states that four men with crosscut saws will fell the timber on a quarter of an acre of heavy forest land in a day. With a daily wage of \$0.25 this would make the cost of felling trees \$4.00 per acre.



THE "UNIT" ANGLO-AMERICAN MILL, WITH SELF-SUPPORTING GEARING, FOR COPRA AND OTHER PRODUCTS. ELEVATION SHOWING, PUMPS, PRESSES, PARING MACHINE, PARING STONES AND KETTLE

Sr. Vicente Diaz, formerly Governor of the Province of Leyte, makes the following estimate relative to the cost of clearing land: 10 men in 2 days will cut the trees and brush on one acre at a cost of \$2.00. After a month one man burns the ground over in one day at a cost of \$0.10 per acre. The fire may continue to burn for three or four days. When it has burned out, 10 men go in and while some of them pile the half-burnt wood and clean the land well, others reburn it, at a cost of \$1.00, making the total cost \$3.10 per acre.

coconut planting in the Philippine Islands is covered either with the tall, coarse grass known as cogon or with a species of bamboo grass which closely resembles sugar cane in appearance, cogon grass being by far the commoner of the two. In order to clean cogon land the grass must first be thoroughly burned off and the land must then be plowed and harrowed repeatedly so as to get rid of the roots. If this is not done the cogon will promptly re-establish itself. If native plows and harrows are used, the land must be gone over four times the first



"COLONIAL" MILL. A 30 H.P. COPRA AND OIL MILL WITH A CAPACITY OF 8 TO 9 CWT. PER HOUR

COST OF CLEARING GRASS LAND.

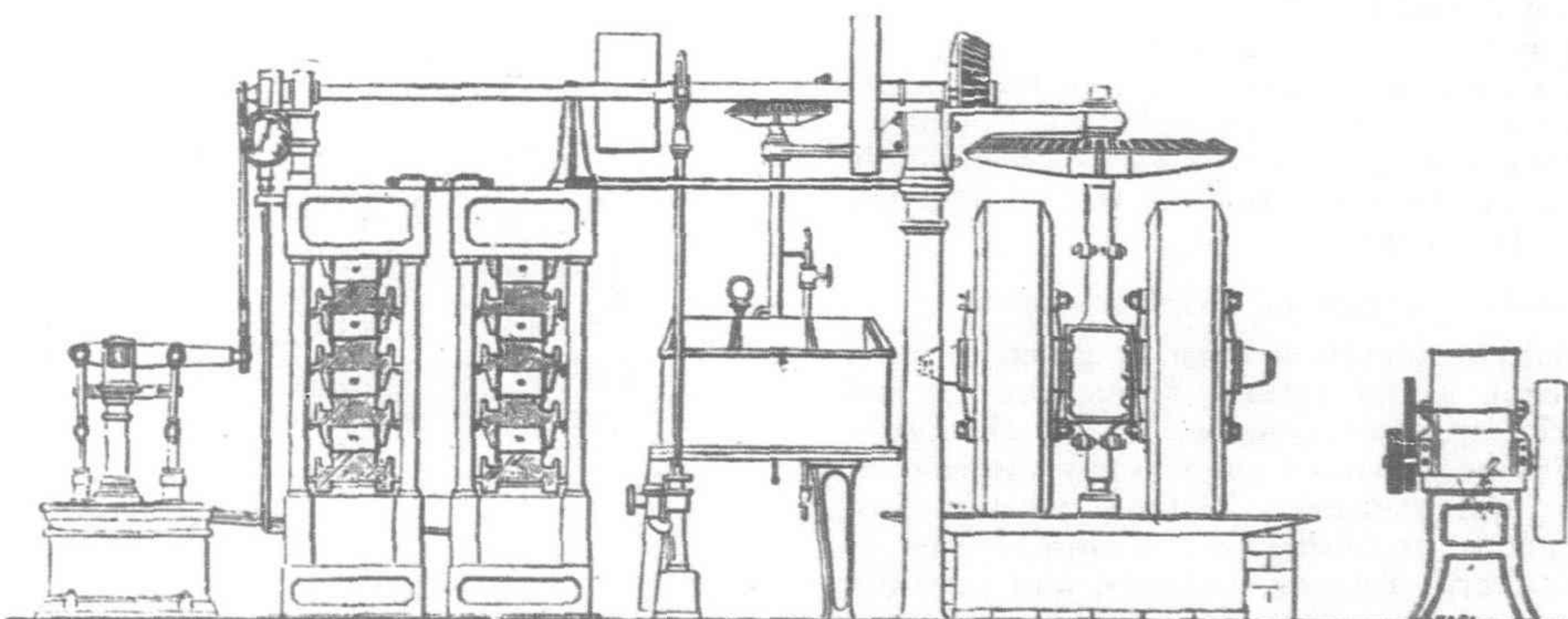
I have experienced much difficulty in getting reliable figures as to the cost of clearing grass land. I have often been assured that it was not necessary really to clear such land before planting coconuts and that it would suffice to take up the sod in the immediate vicinity of the trees, but a very serious objection to such procedure is found in the fact that trees planted in this way are exposed to the risk of total destruction by fire. During the dry season cogon grass is highly inflammable and coconut trees are very readily injured by heat. Furthermore, my own observation is that for at least three years coconut trees seldom do well when planted in grass land which is not thoroughly plowed.

Most of the unforested land suitable for

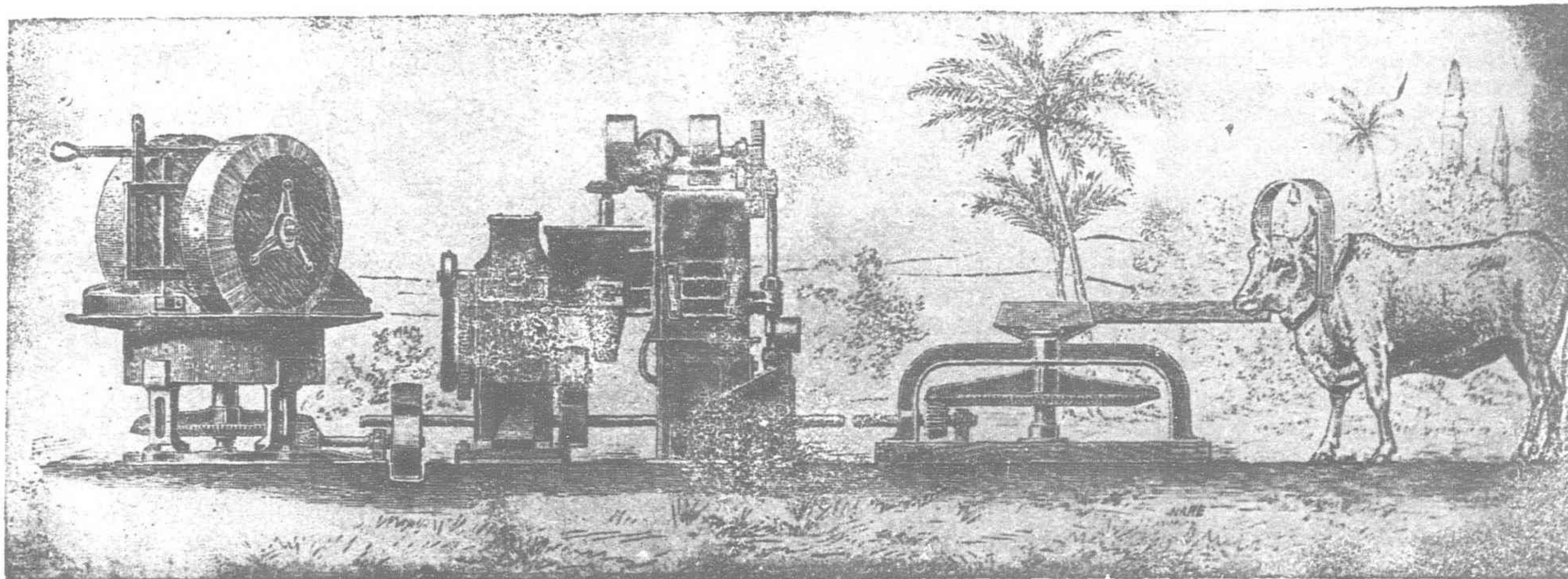
year and the minimum cost will be \$2.00 per acre. It should be gone over twice during the succeeding year at a minimum cost of \$1.00. This cost is based on the employment of one native, with two carabaos, a plow and a harrow, for each eight acres of land, the native taking the catch crops which he raises as pay for his work, so that the cost is represented by the deterioration of animals and tools.

COST AND VALUE OF CATCH CROPS.

According to Superintendent C. H. Lamb, planting with corn or rice will cost from \$0.80 to \$2.00 per acre. In Palawan the minimum returns received from an acre of land is 8 bushels of rice, the average maximum is 20, although 30 is not uncommon. The average value of the unhusked rice is \$1.25 per bushel



COMPLETE 20 HORSE-POWER COPRA OR OIL MILL PLANT FOR CRUSHING 3 TO 4 CWT. PER HOUR, COMPRISING TWO HYDRAULIC PRESSES, 1 SET OF PUMPS, 1 SEED KETTLE, 1 SET OF ROLLS, 1 SET OF STONES, 1 OIL PUMP, ETC.



COMPLETE OIL MILL FOR COPRA AND OTHER PRODUCTS, CONSTRUCTED OF SMALL AND LIGHT PIECES FOR CONVENIENCE OF TRANSPORT
(Manufactured by Rose, Downs & Thompson, Ltd.)

giving an average return from the rice crop of from \$10.00 to \$25.00 per acre.

According to Mr. Lamb three catch crops may advantageously be grown. He recommends first a crop of corn and subsequently two crops of mountain rice, by which time the coconuts will be too large to permit further advantageous cultivation of rice or corn.

The second and third crops may give a profit or may only suffice to cover the cost of keeping the land clean and under cultivation, which is necessary in order that the young trees may make their best growth. It is obvious that as the roots of the coconut trees extend, the amount of ground available for cultivation will become less, while the growing tops will throw a constantly increasing amount of shade.

Sr. Vicente Diaz, formerly Governor of the Province of Leyte, estimates that four men will plant rice or corn on two and a half acres of land in a day. The cost of a bushel of seed, which is sufficient, is \$1.25 and the total cost of planting is, therefore, \$0.90 per acre. This crop is given one cleaning, which takes 10 men one day, at a cost of \$2.50. The harvesting of the rice crop takes 10 men one day, at a cost of \$2.50. The crop is estimated at 20 bushels, worth \$1.00 per bushel or \$20.00.

He estimates the crop of corn at 6 bushels of shelled corn per acre. It is usually worth \$1.00 per bushel or \$6.00 per acre.

According to Mr. C. H. Lamb, the first year's catch crop should yield a profit which should go far toward paying the cost of clearing the land and the second and third years should yield catch crops which will at least pay for the cost of cultivating the land. During the fourth, fifth and sixth years, by the end of which time the trees will have begun to bear, it will be necessary to keep the land clean and there will be no returns from catch crops. He states that the cost of such clearing will average \$2.00 per acre.

Mr. Frederick Lewis estimates the cost per year of keeping an acre of land clean at \$5.00.

Sr. Vicente Diaz estimates that 10 men can clean two and a half acres of ground in one day, at a cost of \$1.00 per acre.

In general it may be said that where soil conditions are favourable for catch crops actual experience has shown that under good management they can be made to pay approximately the cost of the plantation up to the time the coconut trees fruit.

COST OF CLEARING MANGROVE LAND.

Special consideration must be given to mangrove land, as the returns from firewood and tan bark can, according to Mr. C. H. Lamb, invariably be depended upon to pay the cost of clearing and planting. Neither rice nor corn can be grown profitably on this land because of its character. Tapioca, peanuts, and camotes, or yams, can be grown upon it, but as the soil contains so much salt that ordinary weeds do not spring up within two years after planting, the usual, and probably the best, practice is to depend on coconuts alone rather than to attempt

to raise catch crops. It must, however, be remembered that coconut trees planted on this land are not likely to produce so heavily as those planted on more suitable soil and that they are more likely to be uprooted during severe wind storms, as their roots strike the permanent water-table near the surface of the ground and will not go below it.

Referring in detail to the returns from this land,—one man will ordinarily cut 50 bundles of tan bark in a day. Each bundle is worth \$0.10. One man will usually cut one-half cord of wood per day. Deducting the cost of transportation, this firewood will net \$4.00 to \$5.00 per cord on the Manila market.

Coconuts planted on mangrove land will, it is said, bear invariably before they reach the age of six years, and while such land can hardly be recommended for a coconut plantation any of it necessarily purchased in connection with other land can be utilized.

COST OF SEED NUTS.

Good seed nuts will cost from one to four cents each. Two and a half cents may be taken as a fair, average cost.

COST OF PLANTING.

The nuts should be sprouted in seedbeds before planting, and the net cost of placing them in the ground, including the cost of care while sprouting, is estimated at from 2½ to 5 cents per nut.

Under such conditions as prevail in the Philippines, nuts should be planted in straight lines 32 feet from each other in both directions. If planted nearer, the tops of the trees will ultimately overlap. This means 40 nuts to the acre, but as a certain percentage of nuts always fails to sprout, and as a certain additional number will make a weak growth at the start and it is best to plant only very strong growing nuts, 50 nuts to the acre should be allowed.

The cost of planting an acre will, therefore, be approximately as follows:

50 seed nuts at 1 to 4 centavos per nut, \$0.50 to \$2.00.

Sprouting and planting 40 nuts at from 2½ to 5 cents per nut, \$1.00 to \$2.00; making a total of \$1.50 to \$4.00 per acre.

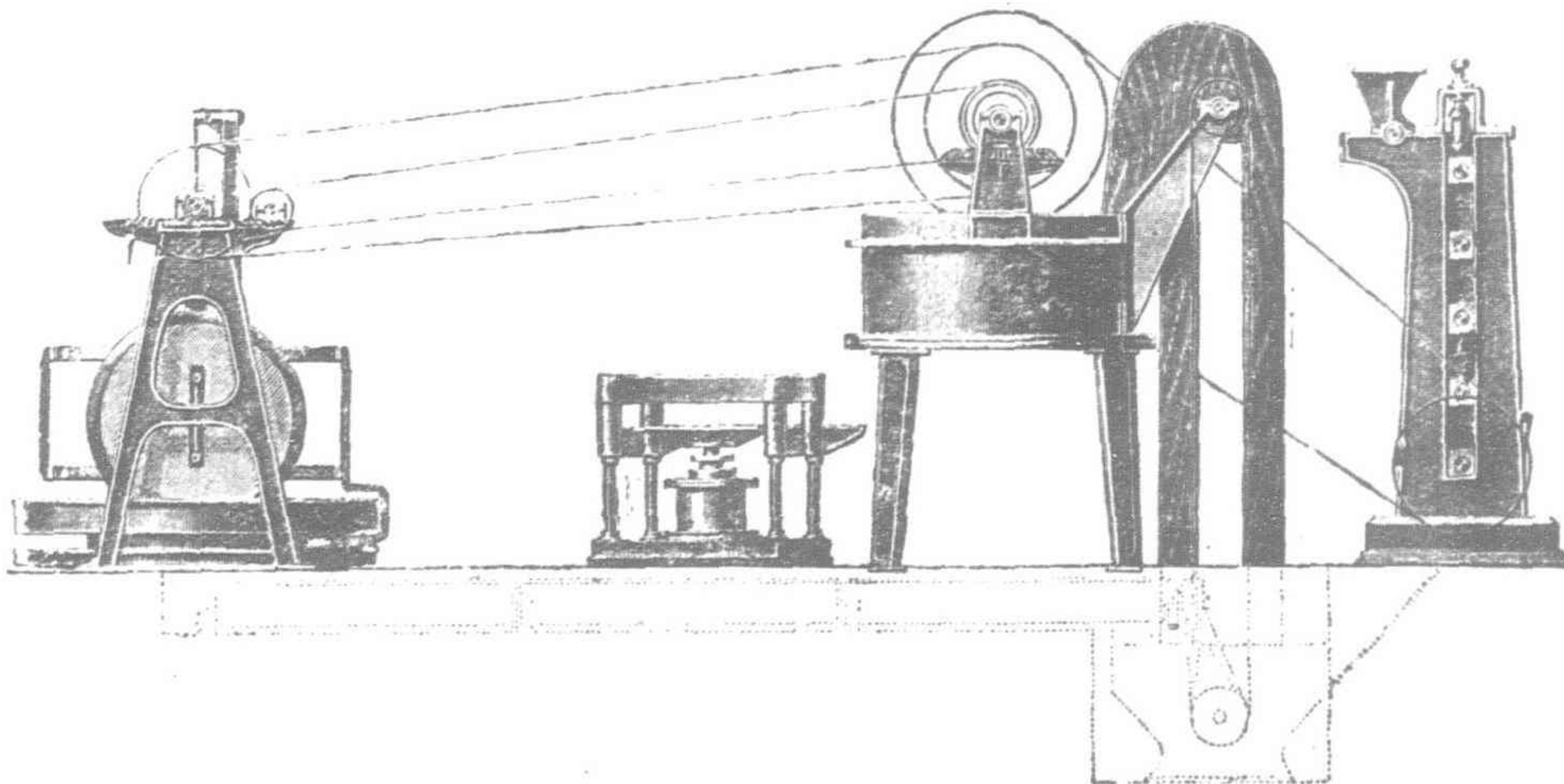
ANNUAL COST OF CULTIVATION AFTER FRUITING BEGINS.

According to a Bureau of Agriculture bulletin on coconut planting annual plowing should be continued during the life of the trees. On cogon land two plowings per year may prove necessary. These plowings should be relatively shallow but should be sufficient to turn under any green manures such as leguminous crops which may be grown to enrich the soil.

I have seen the value of plowing quite conclusively demonstrated on the coconut plantation of Sr. San Augustin, near Calapan, Mindoro. This is one of very few coconut plantations in the Philippine Islands where the trees are set out in straight lines and at proper distances. When I last visited this plantation. I noted that the ground had been plowed between the trees on one side of the highway while on the other side there had been no plowing but the grass had been kept very short by grazing cattle on it. The trees around which the ground had been plowed looked decidedly more flourishing and were bearing more heavily than were those where it had not been plowed.

IMPORTANCE OF FERTILIZATION.

Comparatively little attention has thus far been given in the Philippines to the subject of manuring or otherwise fertilizing coconut groves, but enough has been done to show that in this as in other branches of agriculture proper fertilizing pays. The drain on soil



"UNIT" MILL, END VIEW, SHOWING PARING STONES, MOULDING MACHINES, KETTLE, ELEVATOR AND ROLLS

fertility for 1,000 nuts, weighing in the aggregate 2,125 pounds, has been found to be as follows: nitrogen, 8¼ pounds; potash, 17 pounds; phosphoric acid, 3 pounds.

Dead leaves should be burned and the ashes scattered on the ground about the trees. Husks and shells should also be burned and the ashes scattered on the ground unless machinery is available for making coir, in which case it might be more profitable to utilize the husks for this purpose and to buy fertilizer as needed. Stable manures, press-cake, and tankage are all valuable. When none of these are available, one may sow and subsequently plow under pease, beans, or other soil-enriching crops.

RATE OF GROWTH AND FRUITING AGE OF COCONUT TREES.

The rate of growth and time before fruiting vary in consonance with the varying conditions of soil and climate. Trees planted near the sea coast in Palawan can be depended upon to fruit before they are six years old. I have seen trees four and one-half years old which were already well loaded with nuts. In many parts of the Islands trees do not fruit until seven years old. At considerable elevations above the sea fruiting may be delayed for ten or more years, and if one goes high enough the trees cease to fruit at all. It is always difficult to get really reliable information as to the age of young trees. Especial interest, therefore, attaches to the following statement furnished by the Superintendent of the Iwahig Penal Colony, concerning coconuts at various stations of the Iwahig Penal Colony:

In accordance with instructions received in Memorandum Order Number 2,070, the following statement is respectfully submitted:

On October 5, 1910, a thorough inspection was made of the coconut grove at Binuan, situated on a stretch of black sand adjoining the Bay, and only a couple of feet above its level. The seven hundred trees comprising the plantation were set out during the rainy seasons of the years 1907, 1908, and 1909. Rapidity of growth, vigorous health, and freedom from insect attacks is noticeable in this plantation.

The trees planted in 1907 are about twenty-four feet high, six and three-quarters feet in circumference, and have an average of twenty leaves each, springing from the ground up. *One of those trees is now bearing fruit.*

Those planted in 1908 are on an average fifteen feet in height, three and one-half feet in circumference, and bear about ten leaves each.

The one-year-old plants are six feet high and bear about seven leaves each, and are about eighteen inches in circumference at the ground.

A few of the trees are planted in the hummocky crab ground formerly the home of the mangrove. *These although making fair growth, are not as vigorous as those along the sandy beach.*

On the same date the plantation situated on the Tagulasi promontory was inspected. The five hundred and twenty-two trees here vary in age from *two to six years*. They are entirely free from insect attacks and the same vigorous healthy growth was observed here as in Binuan.

The soil is mostly of a coral formation, but in some places is gravelly, and in other situations of a loamy character.

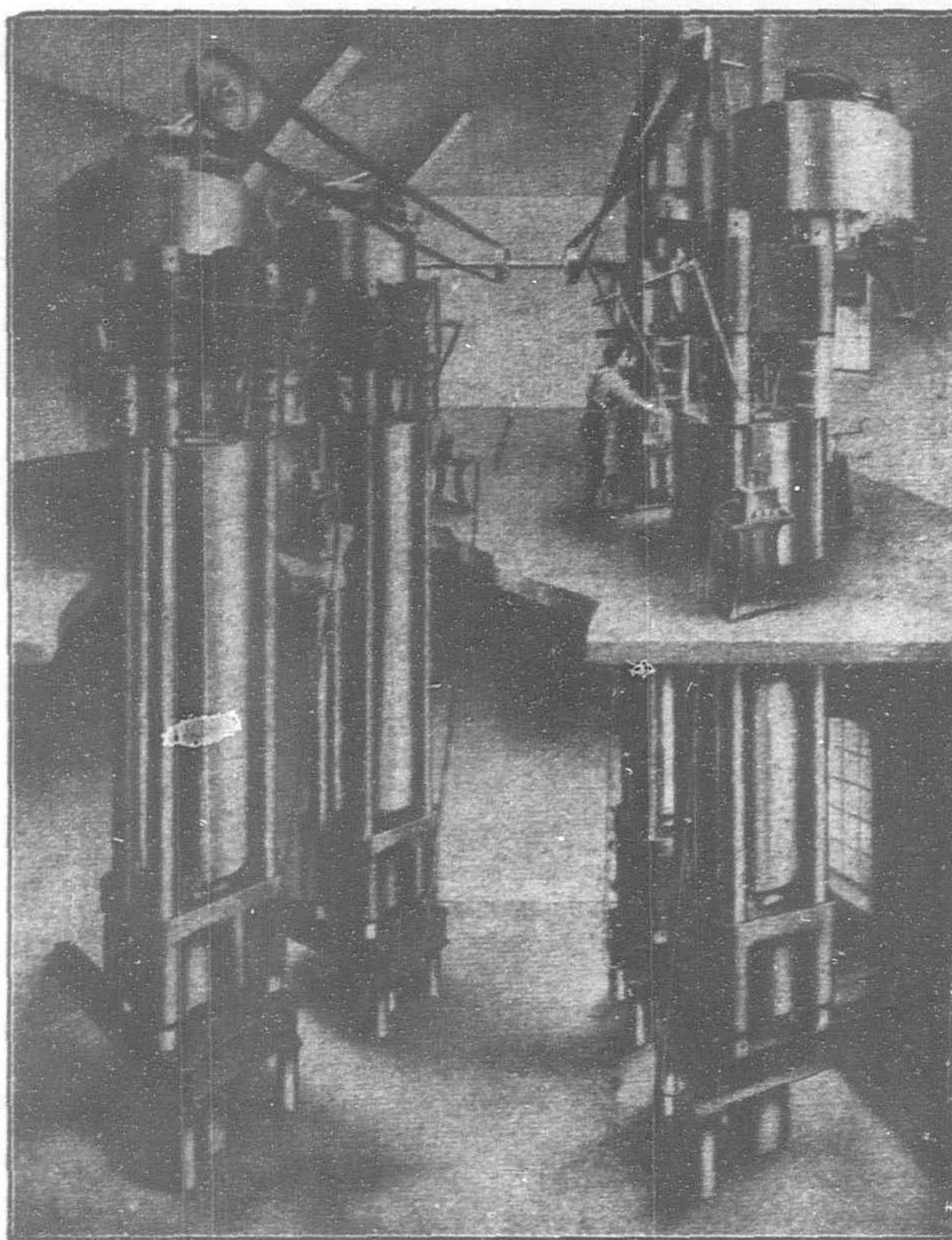
Notwithstanding this, there is not much difference in the growth of the trees, *if we except a few growing on the coral soil near the shore, which seem to have made more headway than the others.*

The other trees which were planted thirty feet apart, *bear from 60 to 120 nuts*, but those planted only eighteen feet apart bear fewer nuts and are characterized by long stems.

On October sixth, the plantations of Kabulbug and Santa Tereza were inspected. The older trees were planted in 1907.

They are entirely free from insects, and although making excellent growth, they are not flourishing as well as those at Binuan, *probably on account of being more inland.*

The circumference of the stems of the 3½-year-old trees is about four and one-half feet; height about 15 feet, and they bear about 15 leaves each.



"PREMIER" HYDRAULIC OIL PRESS, FOR COPRA AND OTHER PRODUCTS
(Rose, Downs & Thompson, Ltd., Manufacturers)

NUMBER OF NUTS PER TREE PER YEAR.

According to a Bureau of Agriculture bulletin, an acre of properly planted coconuts should produce about 2,000 nuts per year, or 50 nuts per tree. The same authority states that trees which by actual count average 50 nuts per tree per year abound; that at Sarabaya trees average 60 nuts per tree per year over hundreds of acres, and that this condition will be found to prevail in Pangasinan, La Laguna, Cebu, Panay, Mindanao, and wherever trees are grown on a generous scale. It is further stated that there are recorded perfectly authentic reports of as many as 128 nuts being taken from a single tree in a year.

One tree at Zamboanga, the owner claims, never produced less than 200 nuts annually, during a period of 23 years. This man claimed that his trees averaged him 100 nuts per year, sometimes falling to 60 and again running as high as 130.

Lieutenant Manuel Fortisch, Philippine Constabulary, reports that at Ginoog, in Misamis, coconuts do particularly well and that a planter there claims 120 nuts per tree per year from old, well-established trees.

Sr. Vicente Diaz states that mature, bearing coconut trees will produce from 60 to 120 nuts per year, with an average of 80.

Mr. P. J. Moore, who is very familiar with conditions in the Moro Province, states that the actual average annual number of nuts per tree in the District of Zamboanga is approximately 45. This includes large numbers of trees which produce no nuts at all on account of being planted too close together. It would, therefore, seem that an estimate of 60 nuts per tree per year for a grove in which the trees were set at proper distances and properly cultivated would be conservative.

HARVESTING NUTS.

Nuts when ripe should be carefully harvested. It is best to cut the stems close to the nuts with a sharp knife or a pair of pruning shears. If nuts are not wanted for seed, they may be allowed to fall to the ground, but if intended for planting they must be carefully lowered as otherwise many of them will be so injured by the fall that they will fail to germinate. Nuts should be harvested every three months and at this time dead leaves and the surplus clothlike

bark which grows about the bases of the leaves should be removed. If it is found that beetles are boring into the trees to any extent, clean, "sharp" sand should be freely scattered in the axillae of the leaves and if any of the large holes made by rhinoceros beetles are found, they should be probed with a hooked wire, the beetles removed and the holes then plugged with wood to prevent them from holding moisture and causing decay.

METHODS AND COST OF COPRA MAKING.

In the majority of cases the method at present employed in making copra is as follows: The nuts are husked by the use of a sort of metal spear point fixed to a stick set vertically in the ground. The shells are then cracked in halves with well-directed bolo (working knife) strokes and are placed in the sun, concave side up. A less common though perhaps more advantageous proceeding is to halve the unhusked nuts with a bolo.

As the meats begin to dry they shrink away from the shell and are then readily removed. They may be dried in the sun until all but about 10 per cent of the moisture has been driven off. If weather conditions are favourable, sun-dried copra is very white and brings a high price, but as coconuts thrive best in regions where the rainfall is quite evenly distributed throughout the year, copra is liable to get wet from time to time when drying and this darkens it.

Unfortunately, in many districts, the Filipinos do not care to take the trouble to sun-dry their copra but place it in bamboo racks under which they build fires. Copra cured in this way is not likely to be anything like so uniformly or so thoroughly dried as that cured in the sun. The smoke turns it dark and the oil obtained from it contains a certain amount of creosote. Any person producing copra on a large scale should install an artificial drying plant.

The system employed for drying codfish at Gloucester, Massachusetts, might well be utilized. A good sized heater causes hot water to circulate through a system of pipes on which are placed "flakes" consisting of rectangular wooden frames over which ordinary poultry wire is spread. These "flakes" are about 10 feet by 6 feet and are slid in place from both sides of the system of hot water pipes, the whole system being some 20 feet wide. The hot water pipes are contained in a closed

chamber in which a number of doors are suitably located. Into this chamber air is forced by a large rotary ventilating fan and the opening or closing of doors causes it to circulate as desired. Copra dried in this way would be snow white, and would bring a peso or two a picul above the regular market price.

The expense involved would be small as dried coconuts husks make excellent fuel, and the ashes from the furnace would make good fertilizer for the growing trees.

Accurate data as to the cost of harvesting nuts and making copra are not available.

It is stated that the average operator will husk a thousand nuts per day and that one man has been known to husk as many as 3,000. The work is hard, however, and \$0.50 per day should, therefore, be allowed as the wage for coconut huskers. A second man should be able to halve and a third to put in the sun the nuts which the first man husks.

I understand that a number of copra making plants in India and Ceylon are now supplied with decorticating, breaking and drying appliances, which make the cost of producing copra materially less than that involved in the use of hand-labour.

ENEMIES OF COCONUTS AND MEANS OF COMBATING THEM.

In the Philippines coconut trees are comparatively free from enemies. In some of the sugar-growing regions the rhinoceros beetle, which breeds in the bagass heaps, sometimes causes considerable losses by boring into the trees, especially if the number of coconut trees is small so that large numbers of beetles concentrate their attacks on individual trees. Other species of beetles, which attack the wood of the trees, have been found, but as a rule their depredations are not at all serious. Insects may best be attacked by destroying their breeding places. The spreading of "sharp," coarse, clean sand in the axillae of the young leaves which are favourite points of attack, is said to be useful. Probing with a stout, hooked wire may be effective in the case of the rhinoceros beetle.

After all is said and done, clean cultivation is the great remedy for insect pests which are not at all likely to cause serious damage on well-kept plantations.

On the mainland of the larger Islands monkeys, crows and fruit bats cause a certain amount of damage by destroying young nuts. Judicious use of a shotgun will reduce to an unimportant minimum the losses from such sources.

Wild hogs are the coconut planter's most serious enemy. On the islands where they abound nothing will suffice but careful fencing until the trees are at least two years old, after which time they are not liable to injury by hogs.

Bud-rot, which causes heavy losses in some coconut-growing countries, is almost unknown in the Philippines. So far as I am aware, it has developed in only one small area in Laguna province. Here it was vigorously attacked and promptly stamped out.

PROFITS.

With reference to this subject Supt. C. H. Lamb, of the Iwahig Penal Colony, makes the following statement:

The conclusion reached, from the writer's experience, is that coconut planting for a permanent crop and investment, cannot be equaled by any other known permanent crop, not even rubber. It is superior to rubber in the Island of Palawan. The usual argument advanced to the contrary, places great value upon the fact that Palawan does not have typhoons which would damage the rubber crop—the same fact is of almost equal value to the coconut. The thing which caused the writer to begin the coconut industry before he had data available which would show the cost of planting, was the short time in which the trees reach maturity and begin to bear.

Sr. Vicente Diaz states that 240 nuts, more or less, will make a picul (137½ lbs.) of copra.

Sr. Palanca of Binuan, Busuanga, gets a picul of copra from 160 to 180 nuts.

Mr. P. J. Moore states that in the District of Zamboanga 180 to 220 nuts make a picul of copra.

The Bureau of Agriculture Bulletin estimates 2,000 nuts per acre. They should produce copra to the value of at least \$50.00.

Mr. J. H. Shipley of the Mindanao Estates Company plantation states that at Davao the average value of the crop of a coconut tree is \$1.00 per year. This would give gross returns of \$40 per acre.

One picul of copra from 200 nuts should be a conservative average on a well-kept plantation and allowing 60 nuts to the tree and 40 trees to the acre, this would give 12 piculs per year, which at \$5.00 per picul would give gross returns of \$60.00 per acre per year from which must be deducted the annual cost of cultivating between the trees, say \$5.00 per acre, and the small cost of harvesting the nuts and making the copra. As coconut trees attain great age and have been known to produce when a hundred or more years old, it is evident that a plantation, once well established, should give steady and large profits for a long period of years.

Hon. Manuel Quezon, a native of the Province of Tayabas, who is thoroughly familiar with the coconut industry there, states that the maximum annual *profit* from a bearing coconut tree is \$1.50 and the minimum annual *profit* is \$1. This estimate is for fire-dried and smoked copra, which is an inferior article, and is based on giving one-half of the copra from each tree to the man in charge. One individual can care for 1,000 trees, and in order to get his half of the copra he must do this throughout the year, cleaning the brush from the ground, removing dead leaves, etc., harvesting the nuts every three months, and drying the copra.

During the past year the best sun-dried copra has brought as high as \$6.00, and even \$7.00 per picul, and the price of copra has held very steady for years, with a slight tendency upward.

ESTIMATED COST OF ESTABLISHING A 2,500 ACRE COCONUT PLANTATION ON RENTED PUBLIC LAND.

The following is a statement of the approximate cost of establishing a 2500-acre coconut plantation and of the revenues which should be derived therefrom at practically the existing market price of copra. It should be remembered, however, that properly dried copra will unquestionably bring a price materially in advance of that commanded by the smoked and imperfectly dried article which at present makes up the bulk of the Philippine product.

This estimate is based on clearing half of the land the first year and half the second year. 200 acres of land are reserved for buildings and other purposes. A more liberal allowance is made for the cost of clearing the land and preparing it for planting than is called for by the estimates hereinbefore quoted and as the returns from catch crops will manifestly depend directly on the character of the soil selected and on the efficiency of the administration of the estate, no allowance is made for them.

Practical experience has shown that under capable administration, with favourable soil and market conditions, they may be made to pay the cost of clearing and planting the land and that of keeping it clean during the first two or three years after it is cleared. I am of the opinion that if this is done it is all that can be expected and I doubt somewhat whether it would be feasible to achieve this result on a coral island. Nevertheless, if I myself were selecting a site for a coconut plantation, I should select one on a coral island which was pretty well isolated in order to avoid possible danger of insect and other pests which might result from the fact that neighbouring plantations, if any existed, were badly cared for.

FIRST YEAR.

	On Ordinary Forest Land	On a Coral Island
Survey	\$ 250.00	\$ 75.00
Rental	256.00	256.00
Clearing and plowing 1250 acres at \$20 per acre	25,000.00	.....
Clearing 1,250 acres at \$10 per acre (plowing not necessary) .....	.....	12,500.00
Cost of seed	1,656.25	1,656.25
Planting 33,000 nuts, at \$.02½ each	825.00	825.00
Fencing	1,000.00	.....
Assistant manager's salary	1,800.00	1,800.00
Assistant manager's house	1,000.00	1,000.00
Labourer's quarters	2,000.00	2,000.00
Storehouse for rice, tools, trade-goods, etc.	500.00	500.00
Well, tank, pumping engine and pipe for water supply	600.00	600.00
1 mile of track (rail, 12 lbs. to yd.)	765.00	765.00
5 cars at \$30 each	150.00	150.00
Tools	500.00	500.00
15 draft cattle, at \$40 per head	600.00	600.00
One American or Australian horse	150.00	150.00
Two native ponies, at \$50 each	100.00	100.00
One 30-foot launch, with 10 h. p. petroleum engine	1,500.00	1,500.00
Launch engineer at \$37.50 per month	450.00	450.00
Kerosene, engine oil, cotton waste, for launch	200.00	200.00
Totals	\$39,302.25	\$25,617.25

Note: A launch is estimated for because unless the plantation is located directly on some inter-island harbour one will be necessary in keeping up communication between the plantation and the nearest port. A liberal estimate has been made for quarters for men, which would allow of putting up a substantial shed, with galvanized iron roof. It would give the men good quarters and could later, at small additional expense, be converted into a drying shed, while the iron roof would be useful for catching rain water, especially on coral islands. A good well, with a pump, tank and pipe is essential in order to provide adequate bathing facilities for the assistant manager and men, and water for animals, sprouting nuts, etc.

It would probably be necessary to run a small store in connection with a plantation at which articles of common necessity should be sold at Manila prices, plus 20 per cent, plus cost of transportation, but labour should be paid for in cash and the men left free to trade at the store or not, as they please.

From the total should be deducted the receipts from catch crops, if any, and from the sale of timber and firewood, which on forest land might somewhere nearly cover the cost of clearing and planting. The sandy soil of coral islands will grow pineapples, peanuts, cassava, corn, or yams, but as weeds do not spring up readily on this soil and as comparatively little work is required to keep it clean, it might be more desirable not to plant catch crops but to leave all plant food in the soil for the coconut trees.

It will be noted that I have provided for an assistant manager only. It would be necessary to have one competent man constantly on the ground. There would be necessity for work in other places in connection with the purchase and shipment of supplies, seed nuts, etc., and the securing of labourers, which should be performed by a manager, and the best way to provide for this unless the owner himself cared to do it would be to have one thoroughly competent man who would serve as general manager for several plantations and who would not only perform the work above referred to but would visit and inspect the plantations at frequent intervals.

If the assistant manager proves capable, his salary should be raised \$200.00 per year until it reaches at least \$3,000.00.

SECOND YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental	\$ 256.	\$ 256.
Clearing and plowing 1250 acres at \$20 per acre	25,000.	.....
Clearing 1250 acres at \$10 per acre (plowing not necessary) .....	.....	12,500.
Clearing 1250 acres of land already planted at \$10 per acre	12,500.	.....
Clearing 1250 acres of land already planted at \$5 per acre .....	.....	6,250.
Planting 33,000 nuts at \$.02½ each ..	825.	825.
Fencing	1,000.	.....
40 labourers' houses at \$25 each	1,000.	1,000.
Assistant manager's salary	2,000.	2,000.
Tools	400.	400.
5 draft cattle at \$40 per head	200.	200.
Launch engineer at \$37.50 per month ..	450.	450.
Kerosene, engine oil, cotton waste, for launch	200.	200.
Depreciation on buildings, track and water system (10 per cent)	451.50.	451.50.
Depreciation on launch (20 per cent) ..	300.	300.
Totals	\$44,582.50	\$24,832.50

NOTE.—From the totals above given should be deducted the receipts from the sale of catch crops and from the sale of timber and firewood, if any.

THIRD YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental	\$ 256.	\$ 256.
Clearing 2500 acres of land at \$5 per acre	12,500.	.....
Clearing 2500 acres of land at \$2.50 per acre .....	.....	6,250.
Assistant Manager's salary	2,200.	2,200.
Tools	250.	250.
5 draft cattle at \$40 per head	200.	200.
Launch engineer at \$37.50 per month ..	450.	450.
Kerosene, engine oil, cotton waste, for launch	200.	200.
Depreciation on buildings, track and water system	451.50.	451.50.
Depreciation on launch (20 per cent) ..	300.	300.
Totals	\$16,807.50	\$10,557.50

NOTE.—From the total should be deducted the value of catch crops, which on forest land should be sufficient to pay the cost of keeping the land clean.

FOURTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental	\$ 256.	\$ 256.
Clearing 2500 acres at \$5 per acre ..	12,500.	.....
Clearing 2500 acres at \$2.50 per acre ..	.....	6,250.
Assistant manager's salary	2,400.	2,400.
Tools	200.	200.
5 draft cattle at \$40 per head	200.	200.
Launch engineer at \$37.50 per month ..	450.	450.
Kerosene, engine oil, cotton waste, for launch	200.	200.
Depreciation on buildings, track and water system (10 per cent)	451.50.	451.50.
Depreciation on launch (20 per cent) ..	300.	300.
Totals	\$16,957.50	\$10,707.50

NOTE.—From this year on there will be no catch crops of importance.

FIFTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental	\$ 256.	\$ 256.
Clearing 2500 acres at \$5 per acre ..	12,500.	.....
Clearing 2500 acres at \$2.50 per acre ..	.....	6,250.
Assistant manager's salary	2,600.	2,600.
Tools	200.	200.
5 draft cattle at \$40 per head	200.	200.
Launch engineer at \$37.50 per month ..	450.	450.
Kerosene, engine oil, cotton waste, for launch	200.	200.
4 miles of track	3,100.	3,100.
1 mile of portable track	1,380.	1,380.
10 cars at \$30 each	300.	300.
Depreciation on buildings, 1 mile of track, and water system (10 per cent)	451.50.	451.50.
Depreciation on launch (20 per cent) ..	300.	300.
Totals	\$21,937.50	\$15,687.50

NOTE.—On favourable land some nuts will be harvested during the fifth year.

SIXTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental	\$ 256.	\$ 256.
Clearing 2500 acres at \$5 per acre ..	12,500.	.....
Clearing 2500 acres at \$2.50 per acre ..	.....	6,250.
Assistant manager's salary	2,800.	2,800.
Tools	200.	200.
5 draft cattle at \$40 per head	200.	200.
Launch engineer at \$37.50 per month ..	450.	450.
Kerosene, engine oil, cotton waste, for launch	200.	200.
Depreciation on buildings, track and water system (10 per cent)	929.50.	929.50.
Depreciation on launch (20 per cent) ..	300.	300.
Totals	\$17,835.50	\$11,585.50

NOTE.—The sixth year a half crop of 30 nuts per tree may be estimated. While all the land in the plantation will need to be cleared in the first instance and kept clean thereafter, it will be safe to allow 200 acres for waste land and for that used for buildings, etc., so the crop of nuts for the sixth year from 1,150 acres may be estimated at 1,380,000, which should give 6,900 piculs of copra, worth \$34,500, less cost of harvesting nuts and making copra.

SEVENTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental	\$ 256.	\$ 256.
Clearing 2500 acres at \$5 per acre ..	12,500.	.....
Clearing 2500 acres at \$2.50 per acre ..	.....	6,250.
Assistant manager's salary	3,000.	3,000.
Tools	200.	200.
5 draft cattle at \$40 per head	200.	200.
Launch engineer at \$37.50 per month ..	450.	450.
Kerosene, engine oil, cotton waste, for launch	200.	200.
Depreciation on buildings, track and water system (10 per cent)	929.50.	929.50.
Depreciation on launch (20 per cent) ..	300.	300.
Totals	\$18,035.50	\$11,785.50

NOTE.—This year a full crop of 2,750,000 nuts may be estimated for 1,150 acres and a half crop of 1,380,000 nuts from the remaining 1,150 acres under cultivation, or 4,140,000 nuts in all, from which 20,700 piculs of copra should be obtained, worth \$103,500.

EIGHTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental	\$ 256.	\$ 256.
Clearing 2500 acres at \$5 per acre ..	12,500.	.....
Clearing 2500 acres at \$2.50 per acre ..	.....	6,250.
Assistant manager's salary	3,000.	3,000.
Tools	200.	200.
5 draft cattle at \$40 per head	200.	200.
Launch engineer at \$37.50 per month ..	450.	450.
Kerosene, engine oil, cotton waste, for launch	200.	200.
Depreciation on buildings, track and water system (10 per cent)	929.50.	929.50.
Depreciation on launch (20 per cent) ..	300.	300.
Totals	\$18,035.50	\$11,785.50

NOTE.—During this year and thereafter a full crop of nuts should be harvested from the entire 2,300 acres, amounting to 5,520,000 nuts, equivalent to 27,600 piculs of copra, worth \$138,000.

CONCLUSION.

It will be noted the foregoing estimate is based on clearing half of the ground the first year and half the second. If labourers and funds are available it would obviously be more advantageous to clear the entire tract the first year as the period when the first full crop could be anticipated would thus be advanced by one year. On the other hand, if sufficient capital is not available at the outset to clear so large a tract as the one indicated a smaller tract of any desired size may be cleared. As the charge for rental of the land is small, there is no considerable pecuniary loss involved in clearing the land quite slowly.

That the above estimate as to the returns which may be anticipated is conservative is shown by the statement of Hon. Manuel Quezon as to the actual returns obtained in the province of

Tayabas under existing unsatisfactory conditions as to planting and care of trees. Under the arrangement in vogue there, and previously mentioned, one man may care for as many as a thousand trees. He receives half of the price of the copra in return for giving the ground such cleaning as it receives, looking after the trees, harvesting the nuts, and making the copra. The net profit to the owner under this arrangement is from \$1 to \$1.50 per tree, an average of \$1.25. On this basis 92,000 trees would give an annual net profit of from \$92,000 to \$138,000, or an average net profit of \$115,000, and it would indeed be remarkable if trees properly set out and cared for in a region well to the south of Tayabas and not subject to the violent wind storms which not infrequently sweep across that province, did not do better than this.

It will also be noted that I have not allowed for any returns except from copra. It goes without saying that it would be advantageous to install a coconut oil mill as soon as the output of nuts in any given region was sufficient to justify it. What appears to be a reasonably conservative estimate of the profits from a coconut oil plant with a capacity of 1,000 piculs a day, running at its full capacity 300 days in the year, shows them to be approximately 120,000 dollars per year. It would take the copra from eleven 2500-acre plantations to keep such a mill running, but the estimate above referred to is based on the purchase of copra in the open market and whatever copra was required in excess of that produced on the plantation or plantations of those interested in the mill could be obtained in this way. In fact a mill might at any time be established at Manila or some other port of entry and be operated at a profit prior to the time when the plantations became productive, so that advantage could be taken of its facilities from the moment nuts were produced.

Actual experience has shown that there is a material loss of the oil in copra during its shipment from the Philippine Islands to the United States or to European ports, this loss being due in large measure to the fact that the mould which grows on copra thus shipped decomposes the oil.

A food product resembling butter, and used as a substitute for it, is now manufactured in large quantities from coconut oil. An important source of increased revenues might unquestionably be found in the manufacture of this product, and of soap, candles, and shredded coconut.

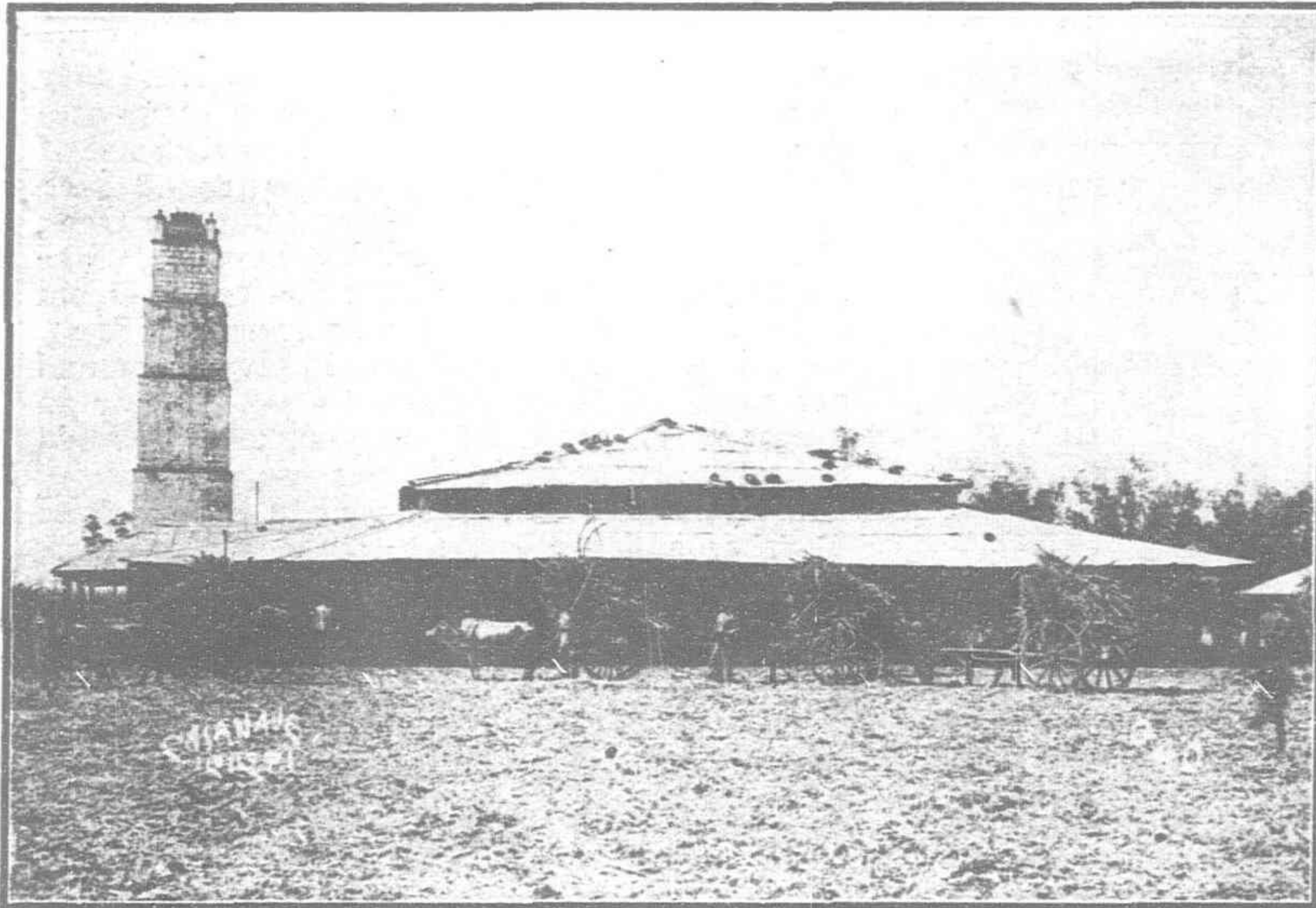
Both coconut oil and all other coconut products from the Philippine Islands are, under existing tariff regulations, admitted to the United States free of charge, which would place a factory manufacturing them at a decided advantage over similar factories in other countries so far as concerns the United States market, which is very important.

Figures as to the cost of a coconut oil plant of the capacity above mentioned and as to the profits which may be anticipated therefrom, will be furnished upon application.

DEAN C. WORCESTER.

A NEW SUGAR FACTORY IN NEGROS.

It has taken many years for the native Filipino planter to overcome his prejudice against the use of modern sugar machinery but there are many signs that he is at last awakening from his long sleep, and is in a receptive mood to improve on the old primitive and wasteful concrete muck factories, which by courtesy have been termed sugar mills. As long as the Insular and near by China market would consume the low grade caramelized output of these mills, at a price which left a good profit to the planter, there was little incentive for him to better his plant, to manufacture a product suitable for foreign refiners. Time and again had some enterprising machinery agent persuaded the ignorant planter that what he needed was a new and larger mill, centrifugals, evaporators, vacuum pan, filter press, &c., to increase his profit, and as the machinery was sold and installed without any co-relation to the rest of the plant, it failed to work in harmony, with the result that it had to be

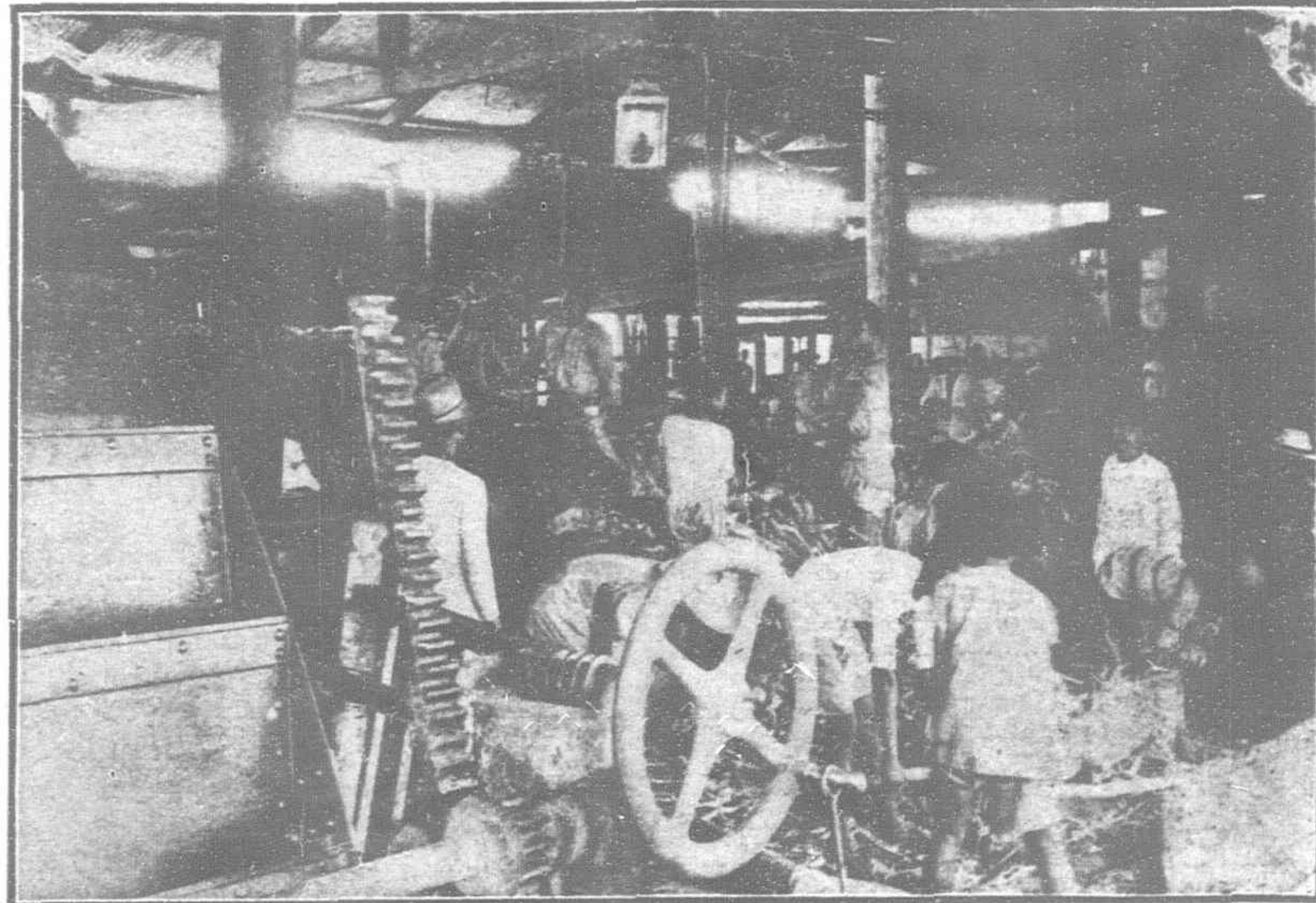


HACIENDA "FE" AT LA CARLOTA, NEGROS, P.I.

abandoned as unprofitable and the old methods resumed.

As a result of American occupation, and the effects of the Payne Bill, giving free entrance to American markets of 300,000 tons of Philippine sugars, the sugar industry has taken on a new lease of life, and several central factories propositions have been floated, and a few of the more enlightened and prosperous planters are improving their existing plants, by the addition of such machinery required in the evolution of a concrete mill into one for the manufacture of centrifugal sugar. The writer is a firm advocate of the large central factory system as best adapted to the expansion of the sugar industry in the Philippines. Owing to the fact that there is little or no native capital to enlarge the existing mills, and also that the estates are too small in area to warrant the installation of a large plant to handle its crop, the large central factory, with a capacity of at least 1,000 tons of cane per day, is undoubtedly the wisest and most economical plan to adopt in the development of the industry.

But at the same time, there are certain advantages in being able to own and operate a plant to handle the crop from any individual estate, and if the owner has sufficient capital or credit, and his acreage will insure him a supply of cane sufficient to operate economically a modern plant, its installation is fully justified at the present time. Experience in Cuba and elsewhere has proved however, that the establishment of the 2,000 ton central factories, in any given district has resulted in the closing



THE MILL AT HACIENDA "ZABORDA," ISLAND OF NEGROS



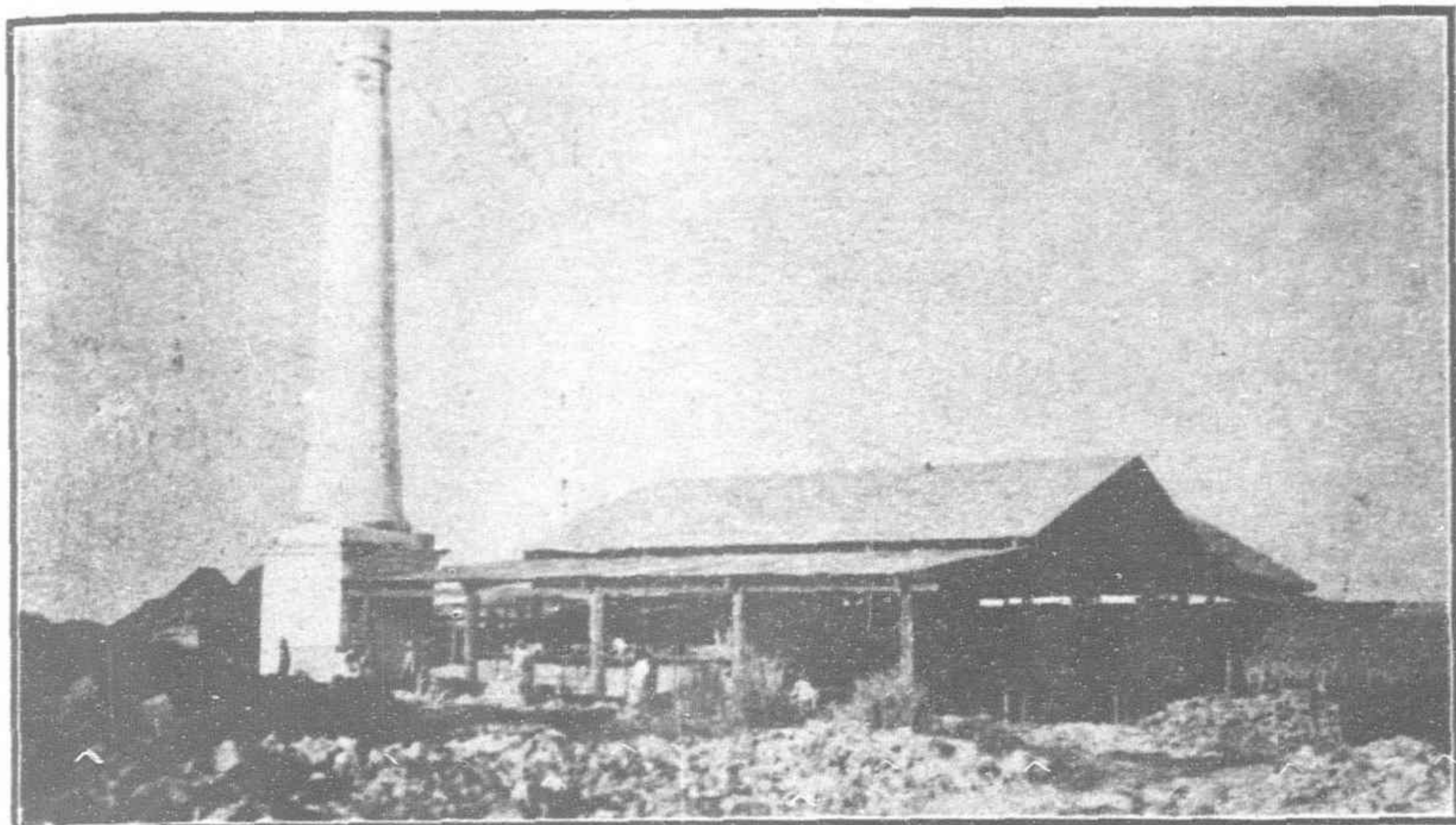
TYPICAL NEGROS SUGAR CANE CONTAINING OVER 16 PER CENT OF SUCROSE

down of all the smaller mills for miles around, and the demand for cane to keep the huge plants working to full capacity, necessitates the purchase of cane from independent farmers many miles distant. But the Philippines have still many years to go, before the industry arrives at that stage, and following the precedent of Cuba, the planter who has now the business foresight to be the first to enlarge his plant, and install complete modern apparatus, if only for a small capacity, will gradually be compelled to increase his plant, to grind the cane of his less fortunate neighbor, and thus develop into a full fledged central factory in due course of time.

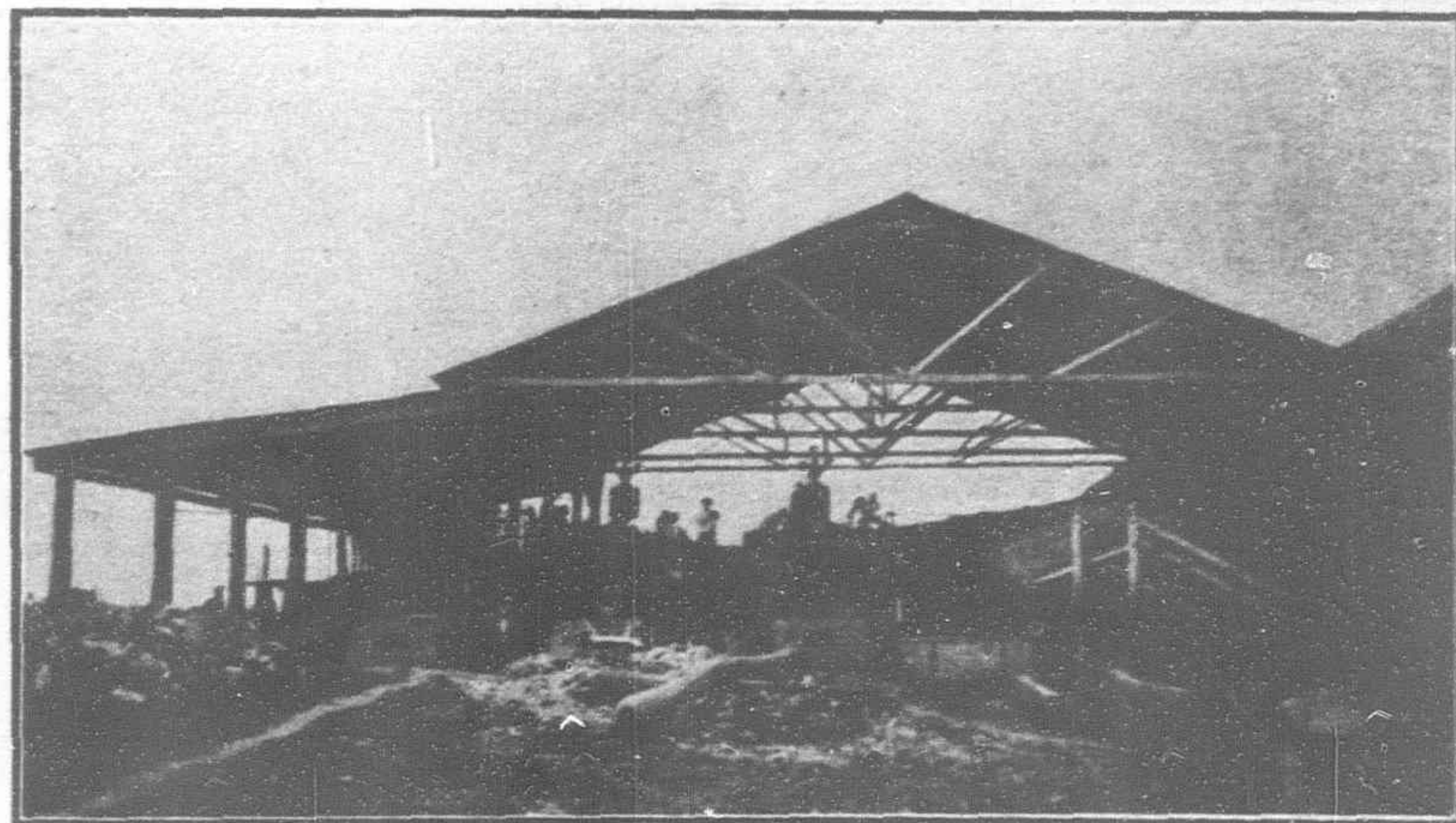
While large central factories operated by foreign capital may not materialize in the Philippines, as fast as expected the smaller plant under native control, will gradually develop in size and be compelled to assume the functions of the central factory. So it is a good sign for the future of the industry, and the prosperity of the Islands, that a few of the native planters have already set the example and enlarged their old outfits into small centrifugal plants capable of turning out a 96 degree product. One of the first to throw aside the traditional conservatism of the Filipino planter and demonstrate a faith in modern methods, were Messrs. Urguijo, Zuloaga & Escobi, proprietors of the San Antonio estate, located in the La Carlota district of Western Negros. With an estate of only 1,165 acres lying at the foot of the



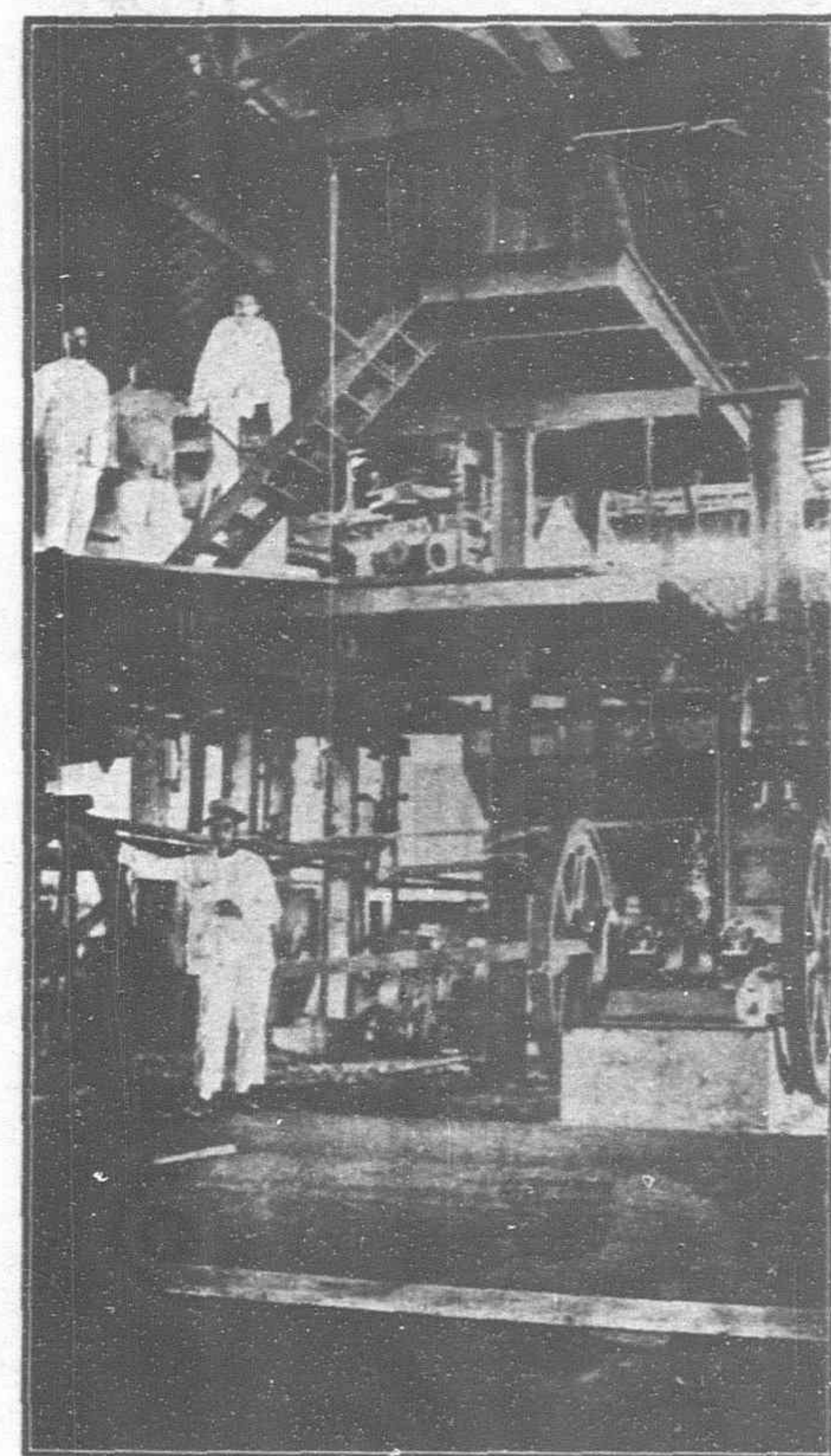
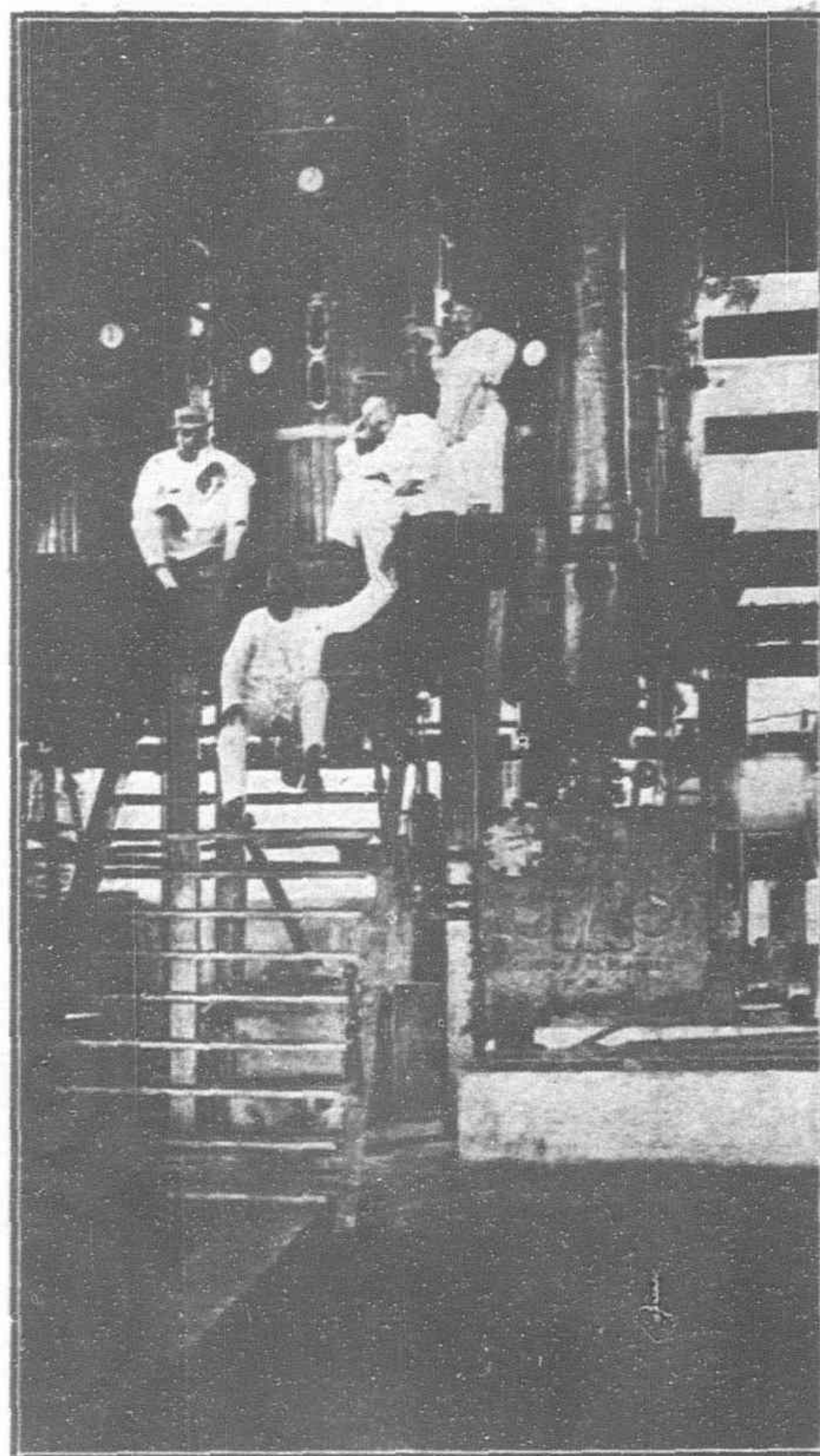
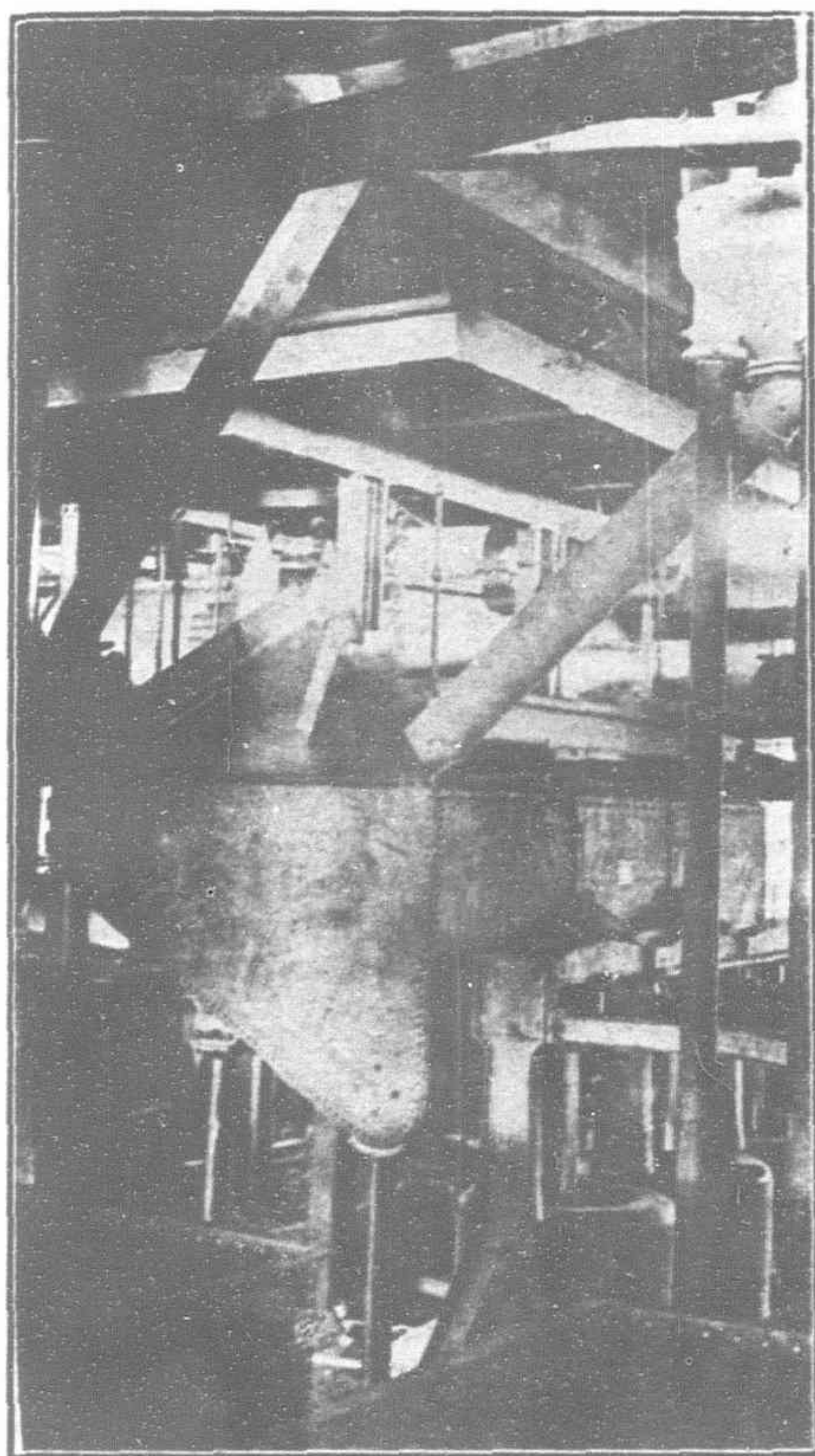
A TYPICAL OLD STYLE SUGAR HOUSE IN THE ISLAND OF NEGROS, P.I. HACIENDA "REFUGIO," SAN CARLOS, NEGROS



BOILER HOUSE, BEHIND FACTORY



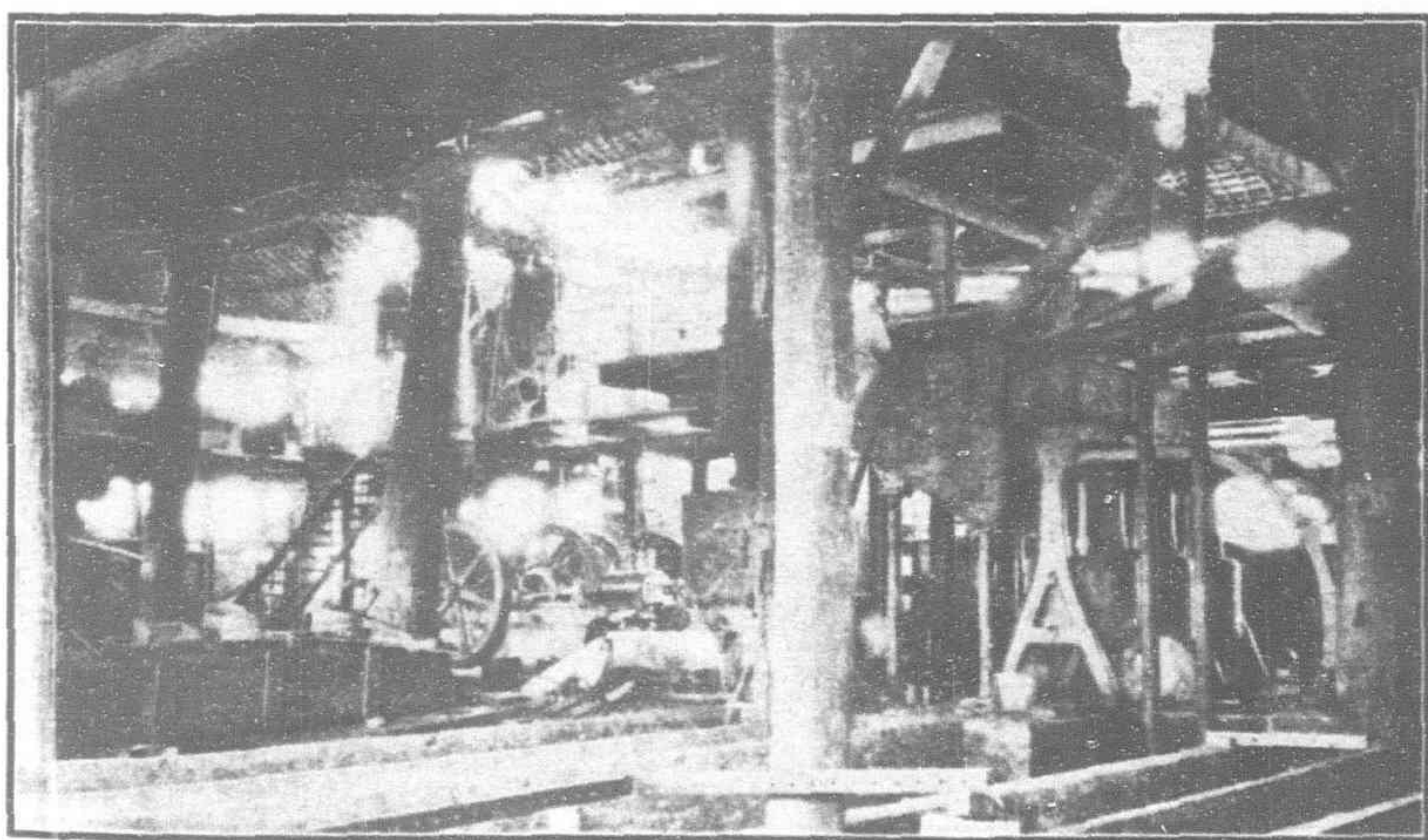
BOILER HOUSE, SHOWING BAGASSE CARRIER AND FURNACES



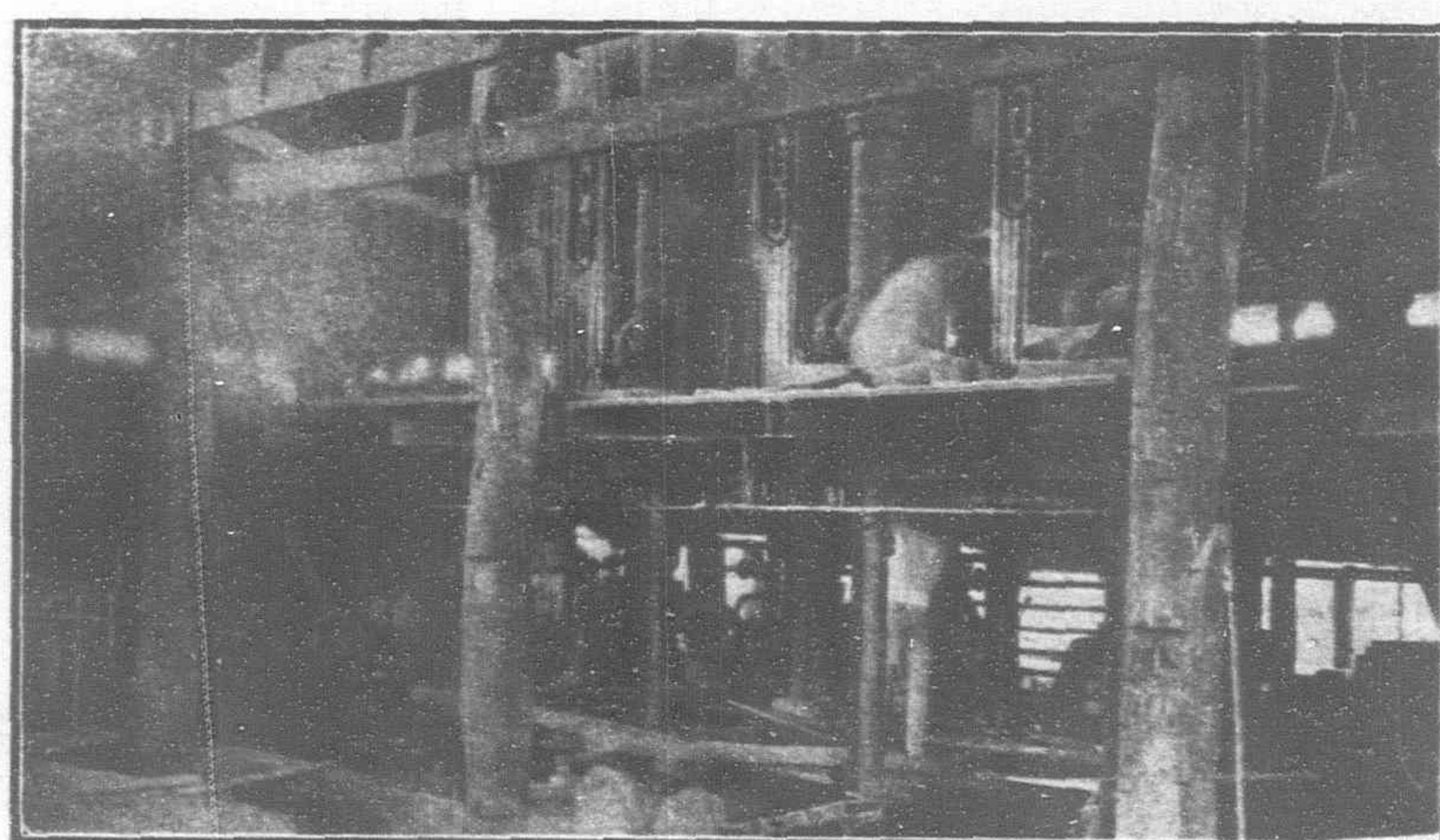
CENTRIFUGALS, MIXER AND SECOND SUGAR TANK

TRIPLE EFFECT AND VACUUM PUMP

VACUUM PAN AND PUMP



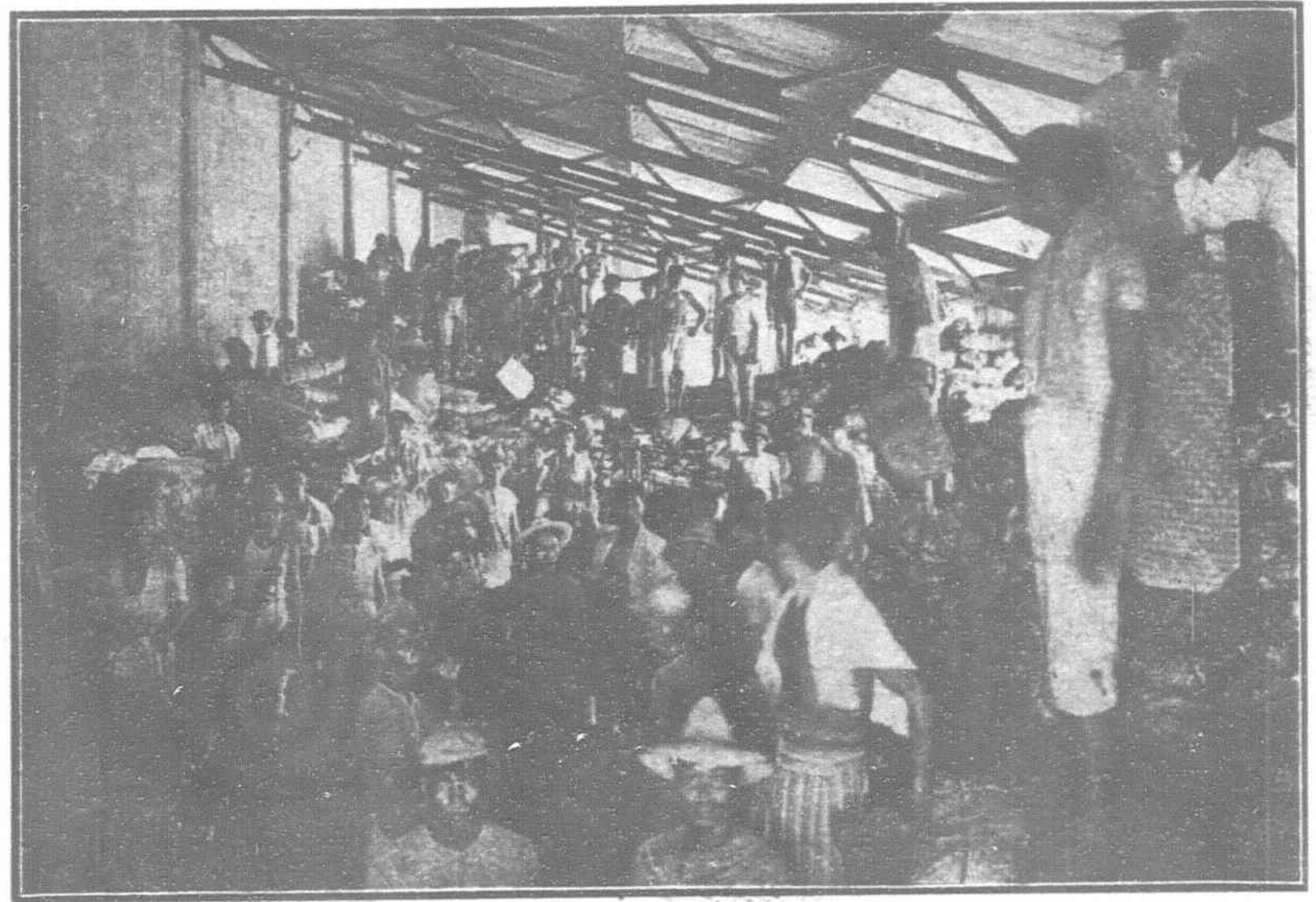
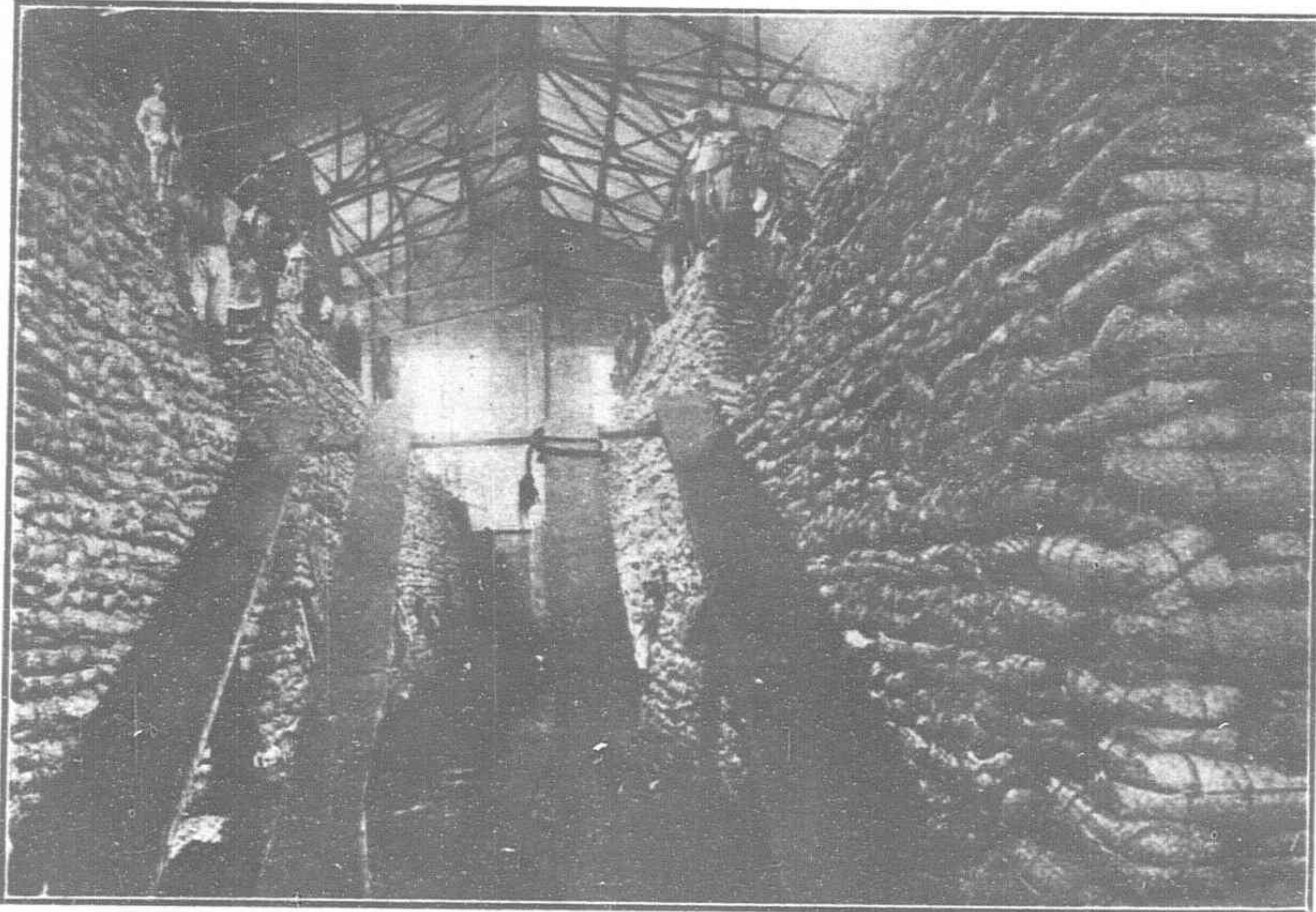
GENERAL VIEW OF INTERIOR, DURING ERECTION



TRIPLE EFFECT AND VACUUM PUMP, DURING ERECTION

THE FIRST MODERN SUGAR FACTORY IN THE PHILIPPINES

The New 150 ton Sugar Factory, Erected on the "San Antonio" Estate in Negros, P.I. By Messrs. Strachan & McMurray of Iloilo, Representing, Aitkin & Co., of Glasgow



NEGROS SUGARS IN THE ILOILO WAREHOUSES

mountains, 15 kilometers distant from the coast, these gentlemen last year ordered a complete plant with a capacity of 150 tons of cane in 24 hours, from Messrs. Strachan & McMurray, the sugar engineering firm of Iloilo, representing Messrs. Aitken & Co., the well known Glasgow sugar machinery manufacturers. One of the conditions was that the plant should be ready for operation at the commencement of the 1912 grinding season, or eight months from the placing of the order. The difficulties of transport, loss of time due to the great strikes in England, the many set backs incidental to installation work in the tropics, and the lack of experienced mechanics familiar with modern sugar machinery, all tended to delay the execution of the contract, and that it was completed in time, is a tribute to the engineers and manufacturers. Those who have had experience in tropical sugar engineering and what it means to install a complete new plant of this size in time to prevent the loss of a crop, will render due credit to the efficient organization and management which made such a task possible.

The "San Antonio" called for the installation of two three roller mills, boilers, green bagasse burners, defecators, clarifiers filter presses, triple effect evaporating apparatus, vacuum pan, centrifugals, cooling tanks and cars, and the various conveyors, pumps, engines and other devices supplementing the main items. The mill is located at the lower end of the estate, and connected with the fields by a light railway. The loaded cars run down to the mill by gravity and the empties returned to the fields by oxen. From the cars the cane is delivered to the mill carrier by hand. The first mill is fitted with a "Diamond" top roller, acting as a crusher, and giving increased capacity for the second mill to crush and extract the juice. The "Diamond" crusher is a patent of Messrs. Aitkin & Co. of Glasgow, and consists of two rollers, both of which have a surface with diamond projections slightly elevated above the surface of the roller, and so arranged that they mesh into each other, crushing the cane, and opening all the cells, so that the rolls of the mill are enabled to extract a much larger percentage of the juice. As a modification of the usual practice of installing the two roller crusher before the first mill, Messrs. Aitkin & Co., have devised a diamond roll which is made to replace the top roller of the first mill unit of a six roller mill, so as to make the first set of rollers act as a crusher. This is the device employed at the San Antonio mill.

On emerging from the rolls of the first mill, the bagasse, is macerated with hot water, to the extent of 10 per cent, before passing on to the second mill. Green bagasse furnaces of the Dutch oven type, have been installed in connection with the multitubular boilers, and being the first burners ever seen in the Islands, came in for considerable "expert" criticism

from the many native planters who witnessed their first performance. The green or wet bagasse, fed direct from the mill as fuel to the burners, was against all the previous experience, and prophecies of the planters that it could not be done, was an object lesson calculated to have beneficial results in the future.

The different processes which go to make up the manufacture of sugar from the juice, are similar as in other small modern plants. After leaving the mill tank the juice is pumped through a Juice Heater, to the defecators,

(Continued on page 98)

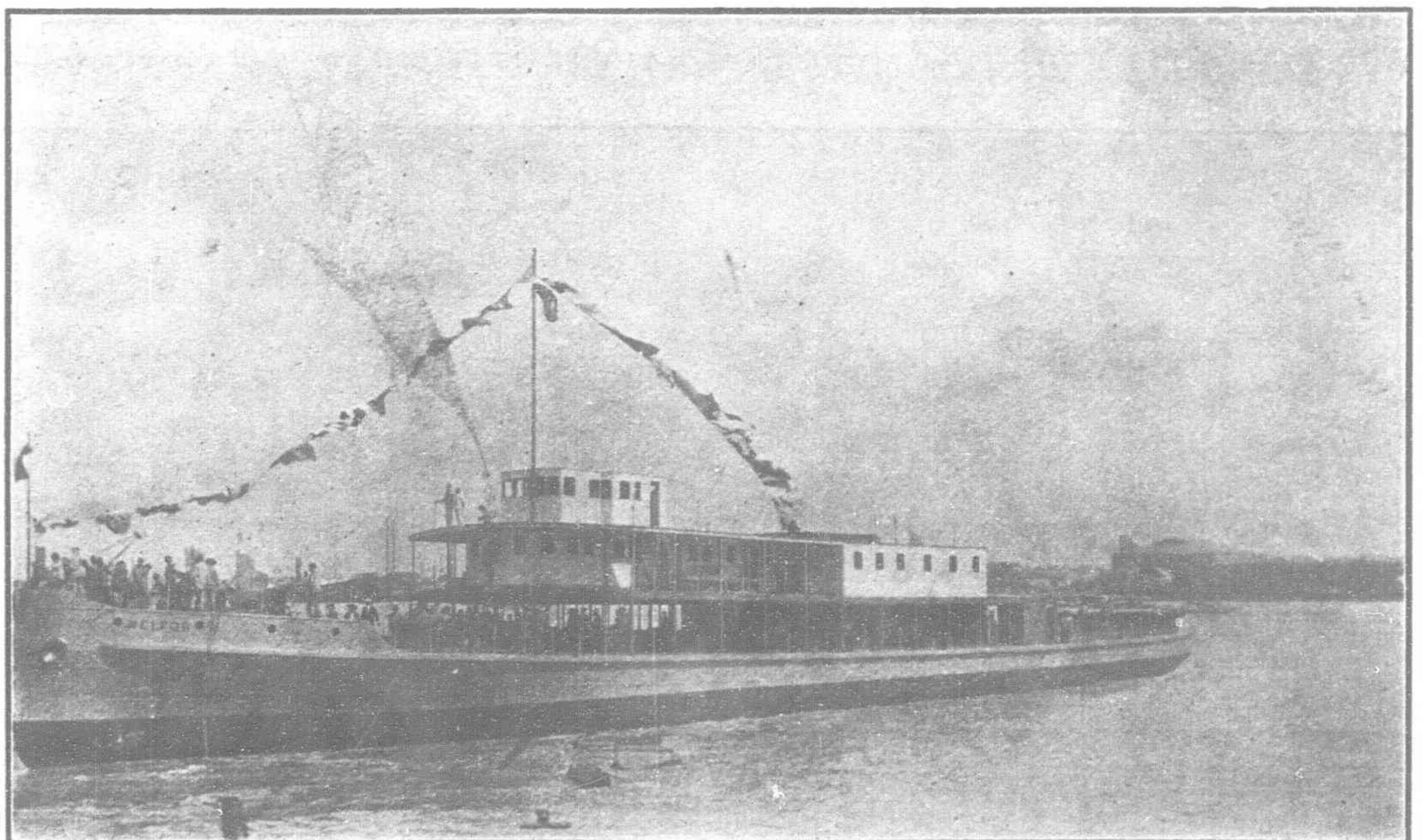
STANDARD OIL STEAMER

On June 18th, there was launched from the yard of the New Engineering and Shipbuilding Works, Ltd., at Yangtzepoo, the steel twin screw steamer Mei Foo, built for the Standard Oil Company for trade on the upper Yangtze.

The Mei Foo is a light draft steamer, fitted to carry 500 tons of oil and 100 tons of bunkers on a 6 feet draft. Her dimensions, moulded, are 240, by 40, by 9 feet 3 inches, and she is built throughout of steel on the tunnel stern principle. Her two sets of triple expansion engines will be capable of developing 1,100

horse power and she will also be fitted with two marine boilers. For the handling of any special cargo from port to port there are a steam windlass, steam capstan, and a steam winch lifting five tons while steam steering gear is also equipped. A motor pinnacle for the purpose of taking soundings in shallow waters has been provided and a spare oil engine will be carried for use while lying in port.

The accommodation is all placed on the upper decks in order to make the vessel a comfortable boat for the officers and crew. She is to run on the upper Yangtze, Hankow, Poyang and Tungting lakes. The Captain's room and wheelhouse are situated on the boat deck. On the upper deck there is a large saloon and state rooms for two engineers and two deck officers. There are also two spare state rooms for any of the owners' staff who may travel with her, and accommodation on the upper deck is also provided for the comprador and Chinese officers. The crew have a spacious forecabin divided for sailors and firemen. She is fitted throughout with electric light. The bulk oil is carried in three tanks divided by a longitudinal bulkheads. The pump house is situated on the main deck and has a Worthington oil pump fitted with suction and delivery pipe capable of pumping out the oil in ten hours.



STANDARD OIL STEAMER "MEI-FOO," BUILT BY THE NEW
ENGINEERING & SHIPBUILDING WORKS, SHANGHAI

THE MINES OF THE ORIENT

THE FURUKAWA MINING COMPANY



FURUKAWA MINING CO.: GENERAL VIEW OF MATU, ASHIO



BRIDGE AT ASHIO COPPER MINES

Wire Manufacturing. The electrolytic copper is melted by a reverberatory furnace, and then cast into wire bars. When the wire bars are properly heated, they are subjected to a rolling mill, where several kinds of wire rods are made. These wire rods are drawn into the wire of desired gauge.

There are eight continuous drawing machines and many single drawing blocks. Small wire is also drawn in this works. For annealing the finished wire we use here the Bates and Peard patent annealing furnace. The hard drawn wire, produced here possesses the following mechanical and electrical properties:

	Tensile strength	Conductivity.
Wire smaller than 150 mils in Diameter.	60,000 lbs. per sq. inch.	98 per cent (Matthiessen's standard.)
Wire larger than 150 mils in diameter.	50,000 lbs. per sq. inch.	(. . .)

ANI COPPER MINES

(Annual production 1,400 tons of copper)

Location. The Ani Copper Mines are in the town of Ani, on the western part of the Mountain, Moriyoshi, in Akitaken.

The area of concession is more than 3,000 acres, and stretches over some 5 miles.

The mines consist of five mines, viz. Kosawa, Kayakusa, Magi, Sammai and Ichinomata, which have ten dressing plants and one reduction works.



MINERS HAND DRILLING, ASHIO

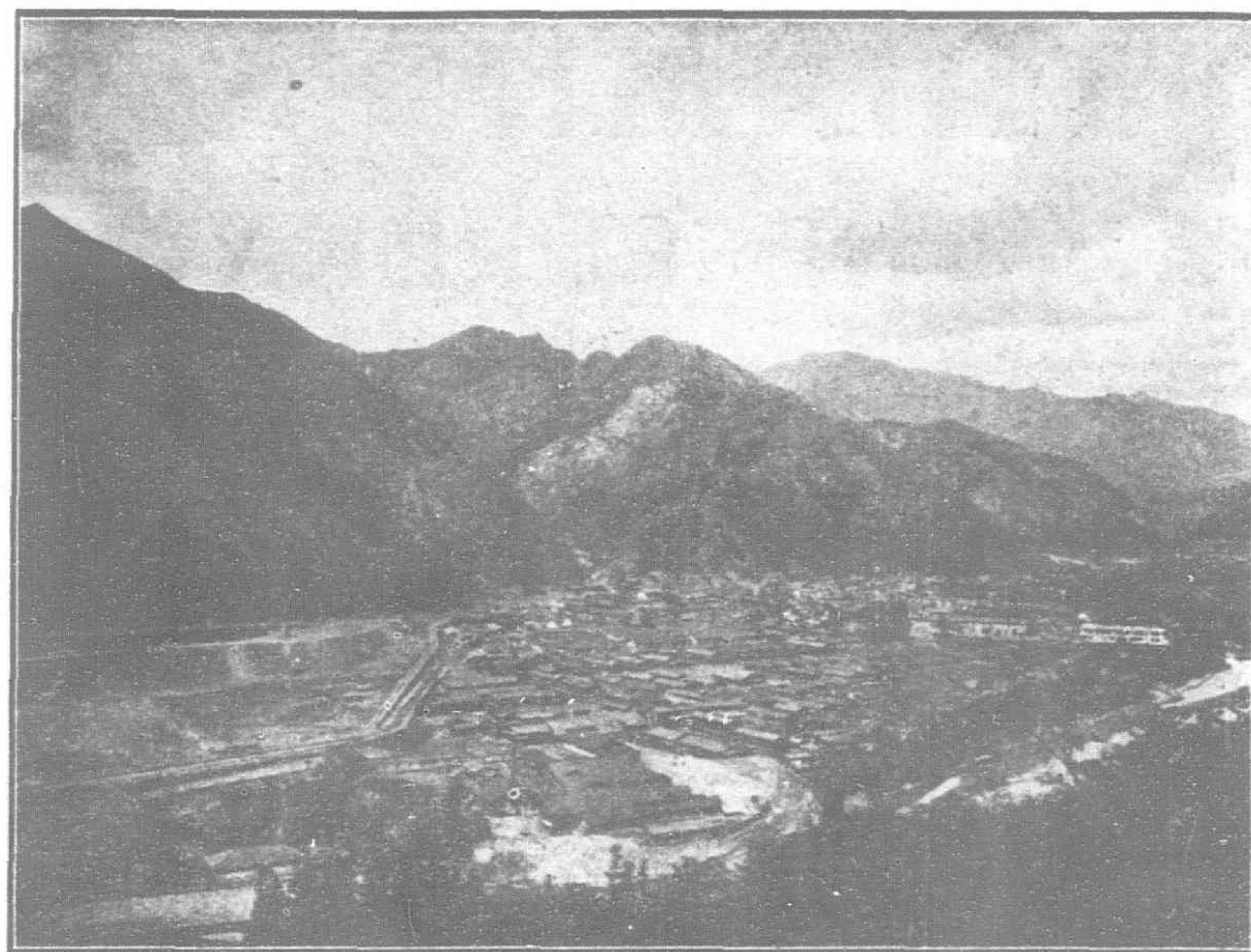
History. The mine Kosawa was discovered in 1670 by a merchant of Ōsaka, and since that time the mines Kayakusa, Magi, Sammai and Ichinomata have been found. In 1702, the whole mines were worked by the Satakes the feudal lords. In 1871, they were transferred to the Imperial Government, and during about ten years they were worked in a large scale under the direction of European engineers. In 1885, they were purchased by the late I. Furukawa.

Geology and Ore Deposit. The geological formation of Ani Copper Mines is Tertiary sediments, liparite, and andesite. The Tertiary is chiefly an alternation of tuff and tuffaceous shale, and extends over a large area. Its general strike is N-S and the dip is 20°-30° to E or W. The liparite occurs as dyke or mass, and it appears as various facies. The andesite is found also as dyke and it is a kind of pyroxene andesite; sometimes it resembles a diabase.

The ore desposit in veins which traverse the whole formation. The strikes of the veins are of two kinds, the first is N 60° W or E-W, called the E W lode, and the second is N-S or N. 30° E, called the N S lode. The dip is usually steep but some of the N S lodes have a low dip, less than 40°. The E W lodes are cut by the N S lodes which are sometimes disrupted veins and occasionally clay veins. The E W lodes are abundant in number, though they are not wide and long generally; and the N S lodes are big but few in number.



GENERAL VIEW OF GINZANDAIRA, ASHIO



GENERAL VIEW OF TSUDO, ASHIO COPPER MINES

The E W lodes in the mines Kosawa, Magi and Sammai, and the N S lodes in Kayakusa Mine are usually worked.

The chief metallic minerals are chalcopryrite associated with pyrite. Sometimes, galena and zincblende occur as crystals on the chalcopryrite and pyrite. The vein stuff is quartz mainly, but sometimes calcite and baryte occur also. The oxidized zone extends deeply; and there are bornite, chalcosite, malachite, chrysocolla, native copper, etc.

The main lodes are described as follows:

Kosawa Mine.

Maehi, Shimoyama-odate, No. 1-10 of Meisei, Chōsei-maehi, Chōsei, No. 8, Banza, Hibira - odate, Ōgihira - odate, Neumahi, etc.

Among them, the last three belong to N S lodes, and the others to E W lodes.

Magi Mine.

Nukanai-odate, Atago, Atago-odate, Yokohi, etc.

The first three belong to E W lodes, and the last to N S lodes.

Sammai Mine.

Irodote, Gonnosuke-okuhi, Kakuchi-yama-odate, Sanryō-odate, Chabakuhi, Neumahi, etc.

The last two only belong to N S lodes.

Kayakusa Mine.

Maehi, Shimotenguhira-odate, Shinsei Shinsei-uwabanhi, No. 2, No. 3, No. 4, Konsei, Kamitenguhira-odate, etc.

Nearly all the veins belong to N S lodes.

Ichinomata Mine.

Shōgorōhi, Yanagiwarahi, Katsuhira-odate, Sasukehi, Ishiganehi, Uwabanhi, etc.

Almost of them run with the strike N 50° E.

Mining

Levels and Shafts. There are a good number of levels and shafts, of which a few principal ones will be described as follows.

Kosawa Mine.

Manaita level:—The adit is situated on the bank of the Kayakusa River. The level is driven by crosscutting at first, and then having proceeded along Shimoyama-odate vein and Machi vein, it penetrates the vein of Meisei, and afterward proceeds along Hibira-odate vein. The level is 10 ft. wide, 7 ft. high and 8,000 ft. long, and double tracks are laid down. It is the most important level for transportation and drainage in Kosawa Mine. Below this level there are four levels at present.

Kambun level:—This is situated 130 ft. above the former level, and is driven in a similar way. It is 7 ft. high, 4 ft. wide and 4,500 ft. long. There are some ten levels above the Kambun level with an interval of 60—80 ft., of which the lower five levels are now in use.

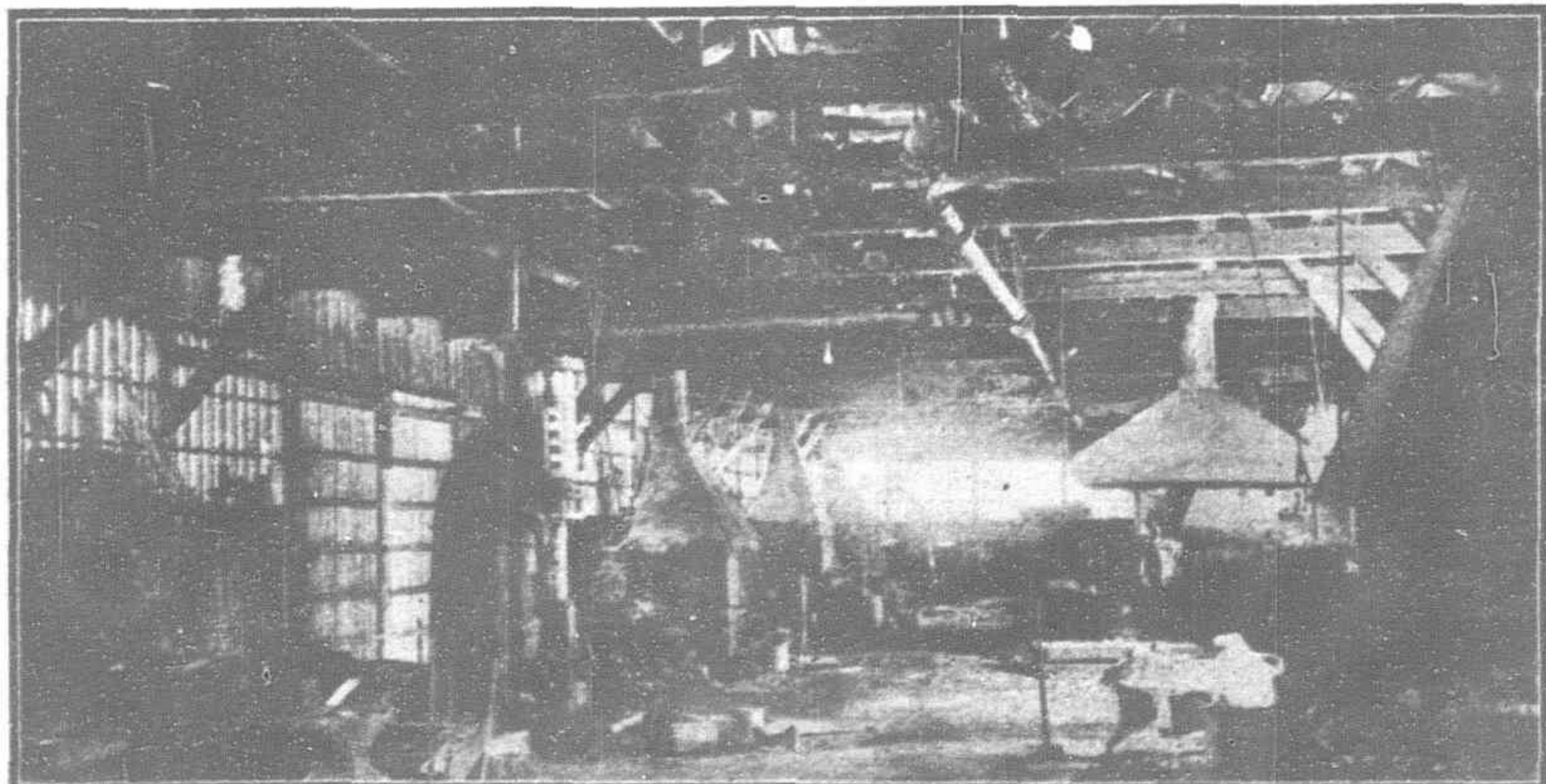
Kosawa main shaft:—The shaft (4 ft. × 14 ft.) is one of the blind shafts, which is sunk at Maehi vein in Manaita level, and it descends for 320 ft. now. Winding and pumping machines are equipped here in the shaft.

Kayakusa Mine.

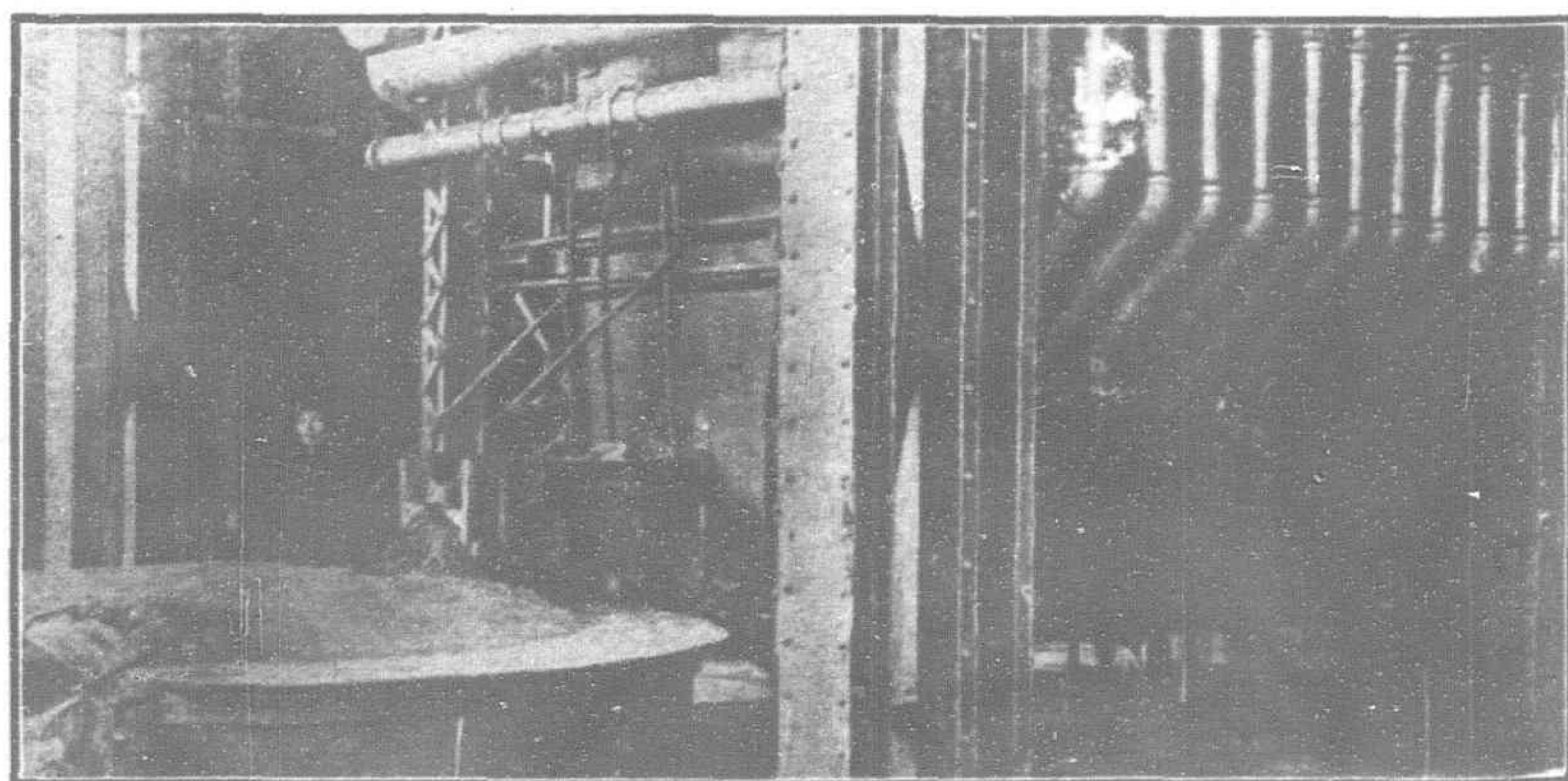
Chōmatsu level:—This is a crosscut which penetrates nearly all of chief veins in this mine. It is 7 ft. high, 10 ft. wide and about 1,000 ft. long, and the most important transportation level. There are seven levels above this level and six levels below.

Sosuidō level:—It is the third level below the former, and is 4 ft. wide, 6 ft. high, and 1,700 ft. long. It is used for drainage only.

Kayakusa main shaft:—The shaft (4 ft. × 14 ft.) is one of the blind shafts which is sunk at Shinsei vein in Chōmatsu level, and is 500 ft. deep at present. Winding and pumping machines are equipped here.



SMITH SHOP, ASHIO



BLAST FURNACE, ASHIO SMELTER

Magi Mine.

Koganehira levels:—It is the lowest level for the transportation and drainage, and is 7 ft. high, 4 ft. wide, and 1,500 ft. long.

Motosawa level:—It is situated at a height of 50 ft. above the former one, driven chiefly along Atago-ōdate vein, and is 6 ft. high, 4 ft. wide, and 3,000 ft. long. There are ten levels above Koganehira level, and they are connected with winzes.

Sammai Mine.

Amaike tunnel:—The tunnel is cut through at the foot of the mountain range between Kayakusa and Sammai valleys. It is only a road for purpose of transportation and communication. It is the lowest level in the mine and is 7 ft. high, 8 ft. wide and 9,000 ft. long, and double tracks are laid down all the way. During the driving of the tunnel, the chief veins in Kosawa and Sammai were found.

Nukibori (special working for the richer part of vein) and dressed ore contract.

Transportation underground. All levels are equipped with rails. Manaita adit, Chōmatsu level and Amaike tunnel are with a double track horse trolley. In the main shafts of Kosawa and Kayakusa, electric winding machines of 45 H.P. are equipped for the transportation from the lower levels.

Pumping and Drainage. In Kosawa, the water below the Manaita level is pumped up by the following electric pumps:

Knowles sinking pump	5 H.P.	1
Escher-Wyss turbine pump	100 H.P.	2
Knowles triplex sinking pump	20 H.P.	2

In Kayakusa, the water below the Suido level is pumped up by the following electric pumps:

Knowles sinking pump	25 H.P.	2
"	20 H.P.	1

Dressing

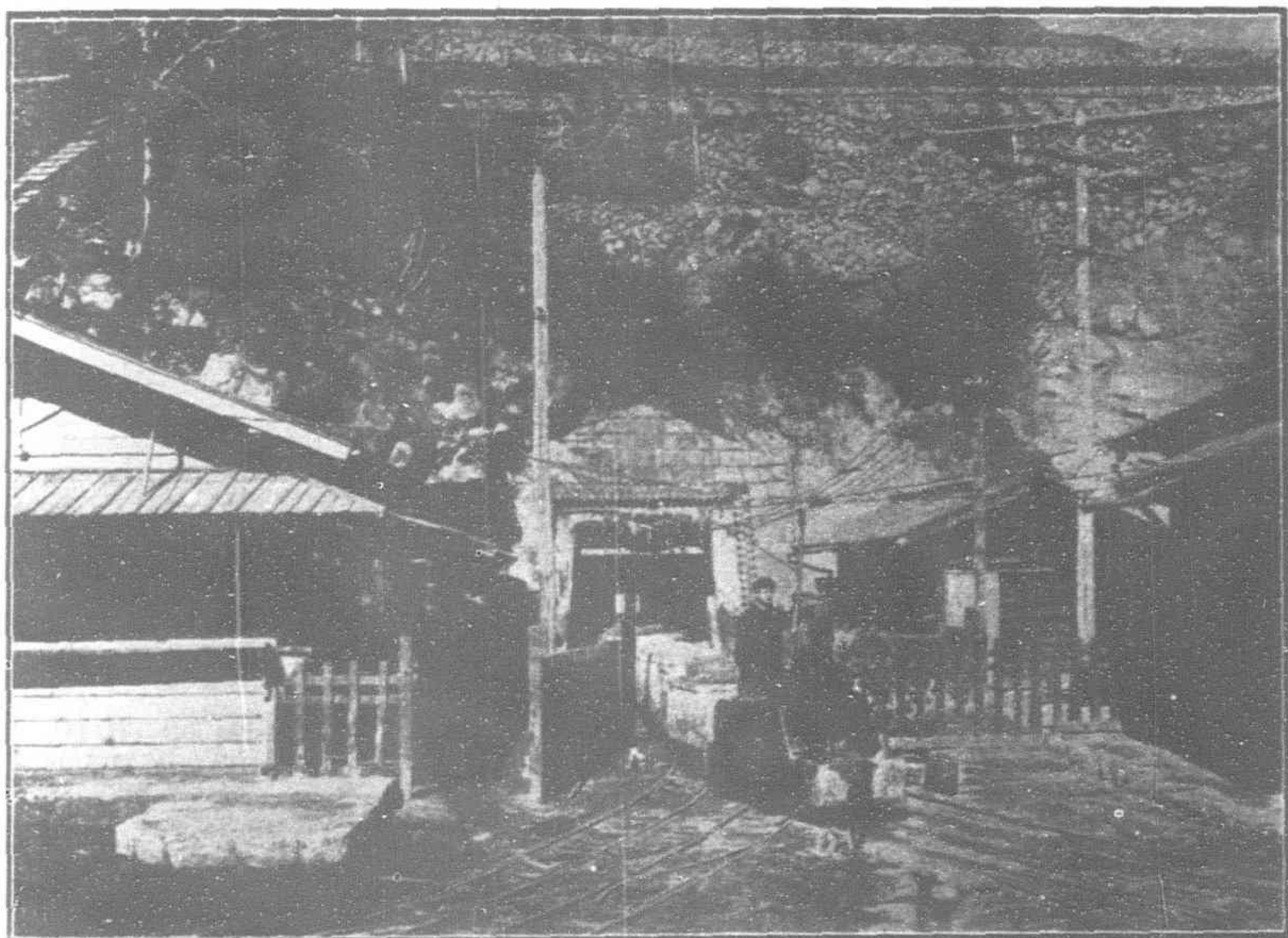
Each mine has its dressing plants: Manaita dressing plant and Naka

works, the other parts are thrown out into the dump.

Reduction

Ores: The dressed ores treated here are chiefly chalcopyrite, associated with quartz and iron pyrites at the rate of 40% silica and 10% copper on average. The receiving ores are classified into four, viz. lumps, grains, sands and slimes, of which the first is only 10% of the total quantity of the ores. About 15,000 tons of ore treated annually in the reduction works, which indicates a production of about 1,400 tons of copper.

Smelting process: The fines are first moulded into briquets and after the drying of the briquets is over, they are roasted in open stall with lump ores. The roasted ores and the grains in a raw state are smelted in blast furnaces with a limestone and *Mabuki* slag, using coke as a fuel. The resulting matte is blown into blister copper by the so-called *Mabuki* process: The



ENTRANCE TO TSUDO ADIT LEVEL, ASHIO



GENERAL VIEW OF INNAI SILVER MINES

Kaei and Mokichi levels:—The former is opened on the back of the Kozama River, and being driven along Irodote vein, is the lowest drainage and transportation level. The latter is situated at an elevation of 240 ft. above the former, and cutting through Irodote vein, reaches to Gonnosuke-okubi vein. Moreover, there are two levels between the Kaei and Mokichi and three levels above the latter. All these levels are connected with winzes.

Ichinomata Mine.

Suidoko adit:—It is driven by a cross-cut at first and then after proceeding along the Shōgorōhi vein, crosscuts several other veins. It is 7 ft. high, 8 ft. wide and 6,600 ft. long, and is the most important transportation and drainage level. There are ten levels above the adit, which are connected with winzes.

Working method. There are three methods of working, viz. stoping,

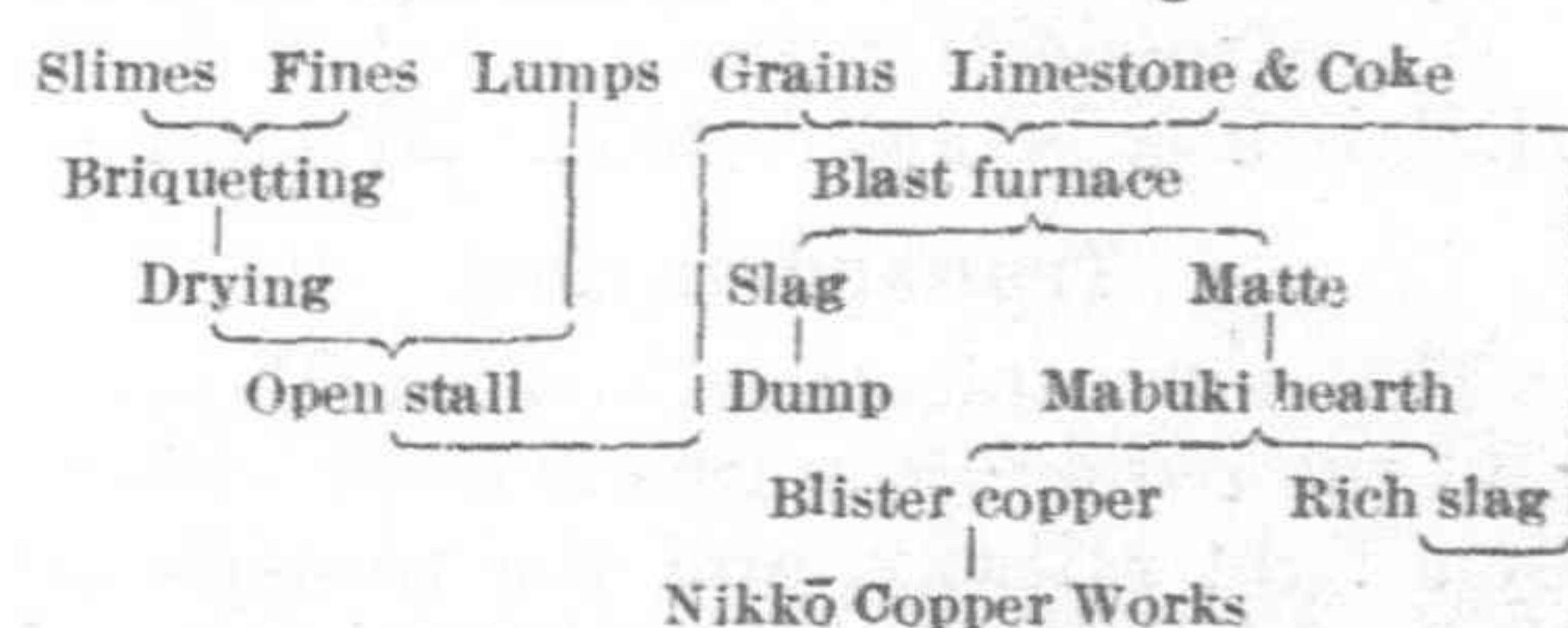
dressing plant in Kosawa Mine; Kayakusa dressing plant in Kayakusa Mine; Koganehira dressing plant, Motosawa dressing plant and Chuoko dressing plant in Magi Mine; Amaike dressing plant, Tsunohikizawa dressing plant and Kaei dressing plant in Sammai Mine; Ichinomata dressing plant in Ichinomata Mine.

Among these, Manaita and Kayakusa dressing plants are equipped with complete dressing machinery which is driven by a Pelton water wheel of 70 H.P. the process is described in the accompanying scheme.

The entire plants treat daily 54 tons of crude ores which carry 4½% copper and produce 38 tons of concentrates of 10% copper.

Each dressing plant has its own precipitating pond in order to settle suspended matter from the waste water. The rich and available parts of the precipitates are sent to the reduction

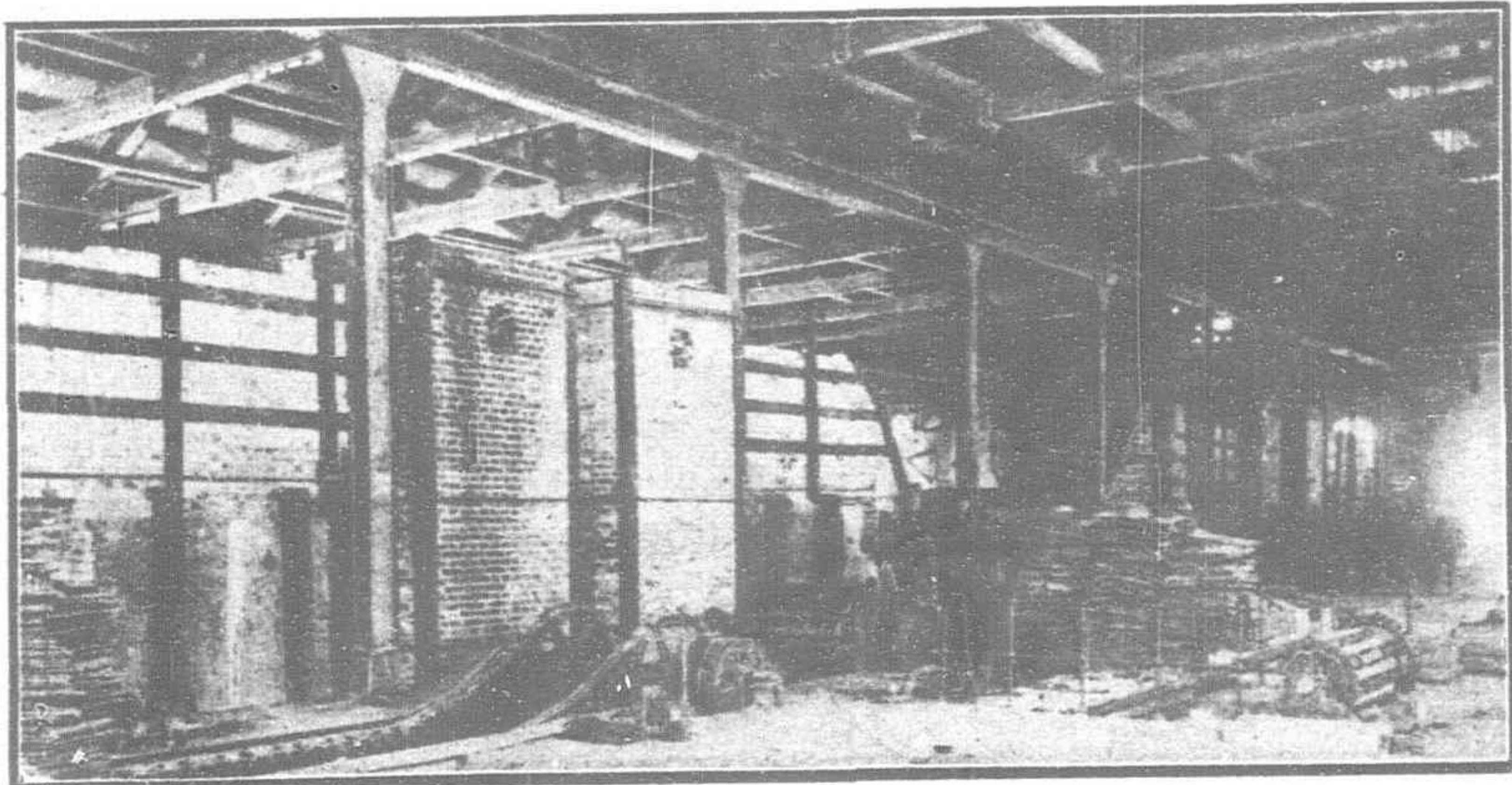
scheme shows the reduction process:



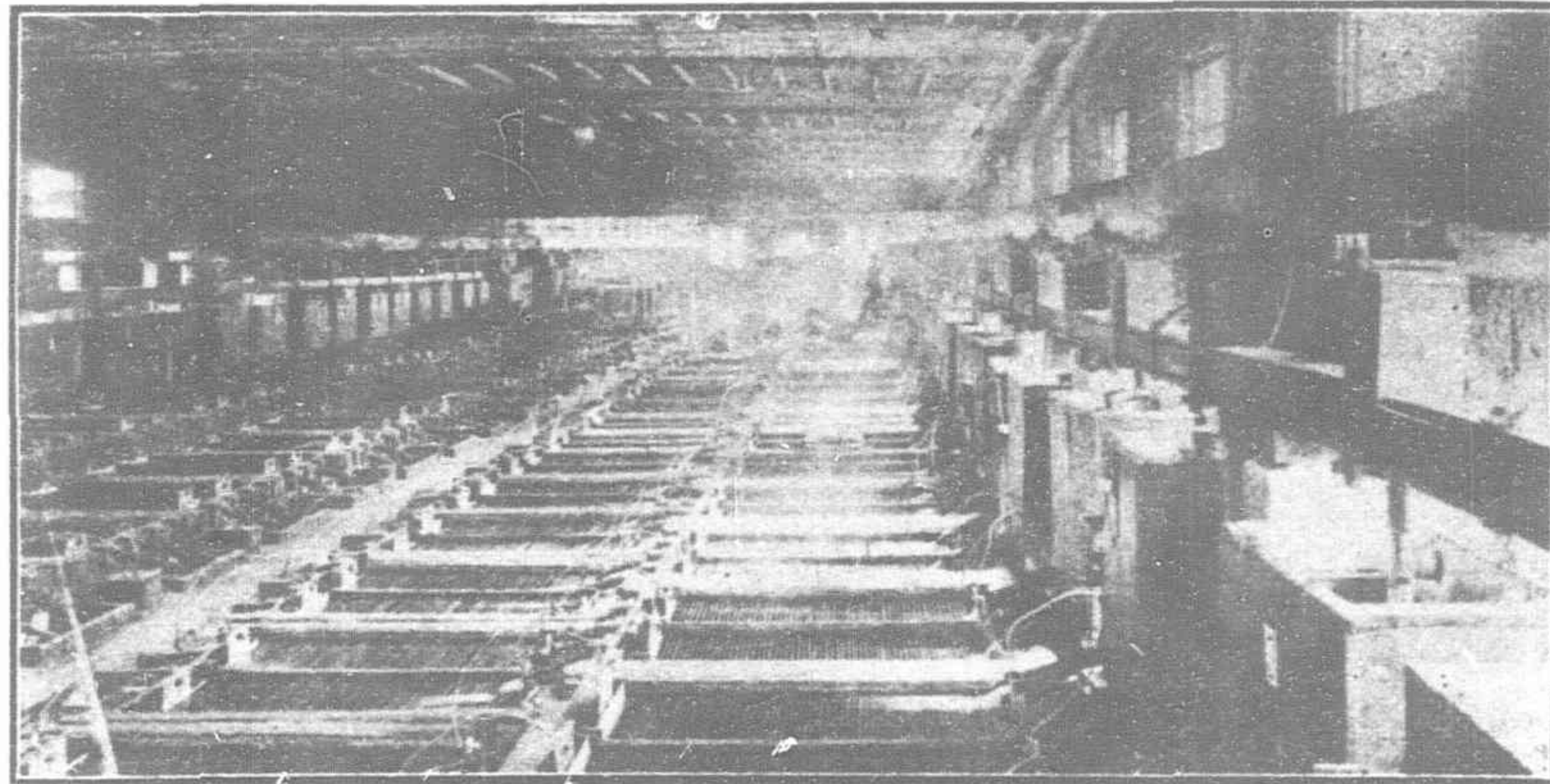
Briquetting and Roasting. The materials for briquetting are of the sands and slimes. The materials are mixed with enough water and clay for proper moulding, and are then moulded in cast iron moulds into briquets.

The lumps and the briquets are heaped alternately in open stalls and fired. The dimensions of an open stall are 8 ft. wide 12 ft. long and 6 ft. high and one charge is 56,000 lbs. of ore. The roasting takes three weeks.

Smelting. There are two blast furnaces partly water-jacketed; one is oval in form, 8 ft. 3 inches × 36 inches at the tuyeres, the other is rectangular,



FURNACE HOUSE SHOWING CASTING APPARATUS, NIKKO COPPER WORKS



TANK ROOM, NIKKO COPPER WORKS

5 ft 5 inches \times 36 inches at the tuyeres, and the smelting capacity of each is 45 tons and 30 tons in 24 hours respectively. The air blast is delivered by two No. 6 Roots blowers to the blast furnaces and the *Mabuki* hearths. The resulting matte of 40% copper is tapped into a matte-pot and then is charged into the Japanese *Mabuki* hearth.

Mabuki. There are seven *Mabuki* hearths. Each hearth is made in the ground with walls of stone cemented with clay and lined with brasque, and has one tuyere. The dimensions of the hearth are 3 ft. in diameter and 1 ft. 6 inches in depth, and the diameter of the tuyere is 2½ inches. The hearth receives a charge of 7,000 lbs. of molten matte. The molten matte is poured from the matte-pot into the hearth, the blast is started, and the *Mabuki* operation is completed every 24 hours. The blister copper contains 98% copper and 0.11% silver.

The blister copper is sent to the Nikko Copper Works and refined by an electrolytic method.

Power

Hydraulic power of 100 H.P. and hydro-electric power of 400 H.P. are used at present. In a hard winter and dry summer, steam power is used to supplement the lack of water power.

A hydro-electric power plant of 1,000 H.P. is now being erected at Hitachinai.

Transportation

The communication between all mines and the reduction works is done chiefly by a light railway, and the transportation of goods between the mines and the station Putatsui of the Imperial Government Railway, is carried on by the River Ani for 20 miles, except in winter time when it is done by sleighs.

FUROKURA COPPER MINES

(Annual production 1,300 tons of copper)

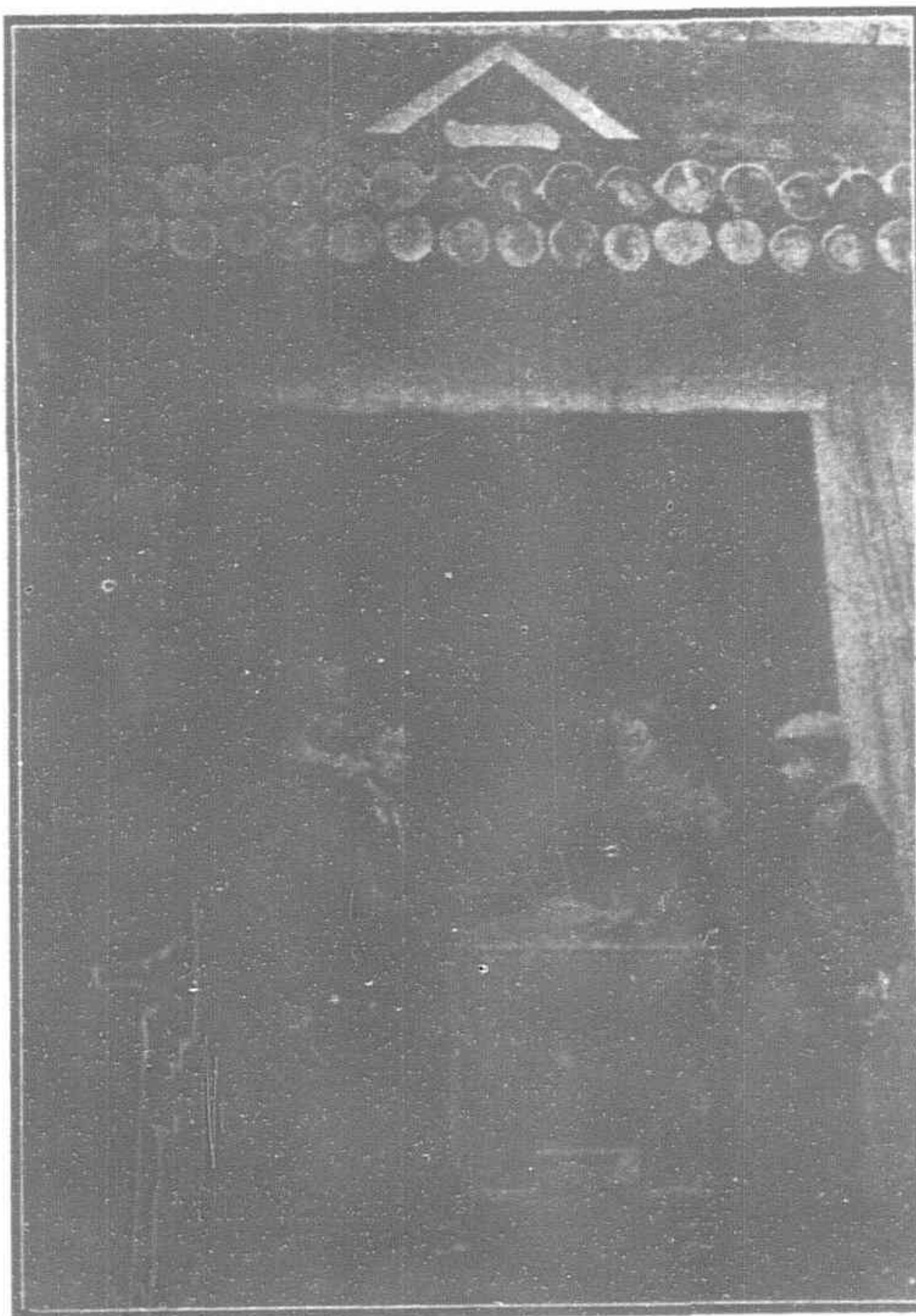
Location.

The Furokura Copper Mines are in the village of Ōyu-mura, in Akitaken. The mines are located on the western slope of the median mountain range in the north of Japan.

The Area of the concession is about 2,200 acres. The mines are divided into two, viz. Furokura proper and Hosoji. The reduction works are situated on the opposite side beyond the mountain range.

History.

The Furokura Copper Mines were discovered by Shōemon Tateyama in 1681, but the working was intermittent, and the production insignificant until they came into the hands of the Nambus—the feudal lords. In 1765, the lord attempted to improve the mines, but unfortunately a disaster in the shape of a terrible famine visited the north of Japan in 1784, and at last they were abandoned in 1794. In 1887, the northern part of the mines—Furokura proper—was purchased by the late I. Furukawa, and in 1904 the southern part—Hosoji—came into the possession of the late J. Furukawa. After the amalgamation of both parts, the mines were developed quickly, and the production has been increased to 1,300 tons per year, since the discovery of the large vein called Shijūnenhi, and the future promises well.



ENTRANCE TO TSUDO ADIT, MIZUSAWA COPPER MINES

Geology and Ore Deposit.

The geological formation of the mines is Tertiary tuff, shale and andesite. The lodes of the mines are the quartz veins which run through all of the rocks. Among them Hompi is the champion lode, which extends through the mines of Furokura proper and Hosoji. It strikes N 30°—40° E and dips steeply N W or S E. The thickness varies from ¾ ft. to 12 ft., and the length is about 5,000 ft. In the middle part of the vein Hompi, there is a branch called Shijūnenhi whose strike is N 60° W and dip is 60° to S. The Shijūnenhi is being excavated now.

The chief minerals are chalcopryite, and pyrite, and the vein stuff is quartz. Micaceous hematite occurs with the quartz, and sometimes calcite is found in druse. Rarely zinblend and galena occur with the pyrites.

Mining.

Main Levels and Shafts.

Furokura proper.

Ōgiri level:—It is driven along the strike of Hompi, 5 ft. wide, 7 ft. high and about 4,000 ft. long. It is the lowest and most important level for the transportation and drainage in the mine.

Kyūshichi level:—It is situated at an elevation of 260 ft. above the former and is also driven along the Hompi, 4 ft. wide, 7 ft. high and 3,700 ft. long. Besides these there are five levels in the mine, which are connected by several winzes.

Ōgiri and Kyūshichi inclined shafts:—The former shaft (4 ft. \times 13 ft.) connects the said two levels, and the latter (4 ft. \times 13 ft.) connects the Kyūshichi and the lowest level of Hosoji Mine.

(To be continued)

A NEW SUGAR FACTORY IN NEGROS

(Continued from page 94)

where it is limed, neutralized, heated to the cracking point, and the sediment and scums drawn off to the filter press tank, and the clear juice to the clarifiers, and supply tanks, preparatory to its passing through the Triple Effect vacuum evaporating apparatus. The density of the juice entering the Triple Effect was about 9 to 10 degrees, Beaumé, the effects working under a vacuum of 5, 15 and 26 inches in the first second and third pans respectively, discharging the juice into the Vacuum Pan supply tank at an average density of 28 degrees Beaumé. The Vacuum Pan working under a vacuum of 27 to 28 inches, turned out a strike for the centrifugals in somewhat less time than was anticipated.

After eliminating the molasses from the massacuit in the centrifugals, the sugar is conveyed to the store room dumped on the floor, thoroughly mixed and then bagged. The molasses is pumped to the Blow-ups, treated and returned to the Vacuum Pan for securing the second product. A series of cooling tanks are used for the crystallization of the second and third products, which are remelted and converted into first products by mixing with the juice in the Vacuum Pan supply tanks.

The sugars produced at the "San Antonio" are finding a ready local market, as well as the molasses.

The plant is designed so as permit of increase to any capacity when required and due to the success of this first experiment with modern methods resulting in increased output at higher values, there is every indication that in a short time, this installation will have to be doubled, thus paving the way for a fair sized central factory in a locality where the cane is unusually rich, and ample land awaiting cultivation.

(Continued from page 61)

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INDUSTRIES

PHILIPPINE ISLANDS

Button Factory.—The La Concha Button Manufacturing Company has been incorporated under the laws of the state of Delaware for \$125,000 U.S. currency of which \$110,000 has been subscribed and paid. The Board of directors of the La Concha Button Manufacturing Company are: Benito Valdez, Clement Schwinges, E. E. Elser, B. W. Cadwallader, and G. Maulinig. The officers are Benito Valdez, president; Clement Schwinges, vice-president and general manager; and E. E. Elser secretary-treasurer. Work on the new factory on calle Bilibid Vilja, Manila, has been commenced, Messrs. Merritt and Wilson being the contractors. The button machinery is of the latest American type and will turn out 10,000 gross of buttons per week, employing 200 workmen.

Standard Oil Warehouse.—The Standard Oil Co., is to build warehouses at Pandacan at a cost of P92,000. They will be of reinforced concrete and steel, and will replace those recently destroyed by fire.

Building and Loan Assn.—The Manila Building and Loan Association held real estate loans at the end of its last financial year to the value of P 500,275 as compared with P 381,827 for the previous year. The total assets of the Company are P 500,275.

Insular Supply Company.—A new firm the Insular Supply Company, has been formed by the co-operation of D. H. Steward and the firm of Smith and Blossom. The firm has already started the erection of a building which will house the Manila candy factory, the Tin shop of Smith and Blossom and several smaller industries.

New Soap Factory.—An area of 3,800 square meters has been purchased in Tandauay, P. I., on which it is intended to erect a large soap factory. Various kinds of soaps, both toilet and laundry, will be manufactured.

Philippine Vegetable Oil Co.—The new concrete and steel structure of the Philippine Vegetable Oil Company will soon be ready for the installation of the plant. The machinery is being supplied and installed by Frank L. Strong, the well known consulting engineer. The plant when finished will be one of the best equipped and promising enterprises in Manila.

Manila Cigar Trade.—The extent to which the Manila cigar trade is prospering is shown by figures issued by the Philippines bureau of customs. The cigars exported during eleven months of the fiscal year 1912 totalled 157,203,000 as against 122,130,000 in the corresponding period of 1911. The monetary appreciation was \$902,432.

Iloilo Water Supply.—Tentative plans have been prepared to provide Iloilo with a gravity system of water supply. The estimated cost is P1,250,000 to P1,500,000. Means to finance the proposal have yet to be found.

Water System for San Pablo.—Plans have been prepared for a gravity supply of 2,500,000 gallons of water daily for the town of San Pablo, Batangas. The cost is estimated at P90,000. The source is the Cabunsod springs, about six kilometres from the town.

Tarlac Plantation Co.—With a capital of P50,000 the Tarlac Plantation Co. has been formed to operate in Tarlac. The organisers are Walter E. Olsen, G. C. Bender, Thos Embry, A. Ramirez, and J. C. Hermann.

Planting Co.—Fourteen Pagsanjan land-owners have pooled their holdings and formed a corporation for the purpose of cultivating more extensive properties. The new company is capitalized at P10,500 fully paid in.

Building Sugar Centrals.—Mr. Stoddard has arrived in Manila from Honolulu to look after the interests of the Honolulu Iron Works in the Philippines. The Pacific Commercial Co. is representing that Company there and have deals for three sugar centrals about consummated. The erection of these plants will keep Mr. Stoddard busy for some time to come.

The Pacific Commercial Co. has acquired the American Hardware and Plumbing Co., Manila, buying out the half interest of Henry M. Jones. The business will be conducted under the old name.

New Sugar Company.—The San Carlos Sugar Milling Company has been formed with a capital of \$400,000 to manufacture sugar in the Philippines. The Company was organised at Honolulu, and will operate in the Southern belt of the Islands.

Amalgamation.—The Philippine Construction Company is to absorb the interests of the Manila Construction Co., Oscar & Campbell and J. E. Ainsworth. The capital will be P500,000.

Eastern Trading Co.—This concern, which has been in business in Manila for some time has been incorporated with a capital of P75,000.

Soap Company.—The Philippine soap Company will spend P30,000 remodelling its buildings, and will then extend its manufactures to fine toilet as well as bath and laundry soaps. Thomas J. Wolff is the President of the Company.

Loaog Bridge.—An allotment of P50,000 has been made available for the erection of the Loaog bridge on the Manila North road.

Columbia Club House.—The Columbia Club proposes to expend from P20,000 to P30,000 on extensions to their club House.

Capiz Statehouse.—The new provincial building at Capiz was inaugurated on the Fourth. The total cost of the building was P114,795.77.

Fireboats for Manila.—The Manila Municipal Board is considering the purchase of fireboats at a cost of P150,000. Two boats have been recommended, equipped with larger pumps, at a cost of P16,000.

Business Houses for Manila.—W. J. Odom sent in the lowest tender for the erection of the block of buildings to be known as the kneedler block. His price was P115,816 to be finished in eight months. P119,000 in seven months. The block will be modern reinforced concrete four storeys high.

Sugar Mill.—A million peso sugar mill is contemplated for the Calamba sugar estate, Laguna province, which was purchased recently by John M. Switzer.

Tarlac Irrigation.—An allotment of \$600,000 has been authorised for the completion of the San Miguel irrigation system in Tarlac. It is hoped to have the system completed in August, 1913. The larger part of the area to be irrigated comprises the Luisita estate of the Compania General de Tabacos de Filipinas. The system at present planned will cost not less than P1,000,000.

Jaro River Bridge.—J. E. Ainsworth was the only one to bid for the Jaro River Bridge—two steel spans 39.62 metres (130 feet) on concrete substructure. The price is estimated about P22,000. W. H. Lambert & Co. of Iloilo have the contract for the superstructure steel.

Steel Electric Cars.—Three handsome steel passenger cars of latest design are now in commission on the Manila Electric Railway. They were manufactured by J. G. Brill & Co., of Philadelphia. The cars are fitted with side vestibule doors, under the control of the motorman.

Calumpit River Bridge.—The Manila Railroad Company is building a new bridge at Calumpit, over the Calumpit river, the bridge is being extended on each side by a roadbed to be used for foot passengers and wagon road.

Roads in Cavite.—The five kilometers necessary to complete the road from Dasmarinas to Silang, Cavite, will soon be under construction, due to an insular allotment of P30,000 made for that purpose. It will give a direct outlet for that section of Cavite to the railroad at Bacoor, and provide a desirable highway from Silang direct to Manila. There has been P85,000 already spent on the construction of this road, but it had to be abandoned on account of a shortage of provincial funds.

Quingua Bridge.—The Atlantic Gulf & Pacific Co. have recently been awarded the contract for the furnishing of the fabricated steel for the super-structure of a bridge over the Angat River, at Quingua, on the Manila north road. The bridge will be three steel spans of 39.62 meters (130 feet) on concrete substructure. Tenders are asked for erection of the super-structure and construction of the sub-structure.

Record Copra Crop.—O. P. Barrett Chief of the experiment division of the bureau of agriculture on his return from San Pablo to Manila said: "My recent visit to the coconut district inclines me still further to believe that the Philippine coconut will endure ill treatment and bad weather than the same tree in any other country of the world. The outlook for a record copra crop for 1912 is practically assured. In the districts of Laguna and Tayabas the output of this year will be surprisingly better than last year; in fact, in some districts it may be nearly double the 1911 crops. There is, however no prospect of decrease in price, which to the motto 'Plant coconuts, then some move and take care of them,—and you will live happy ever after.'"

Pumps and Boilers.—A contract for two compound pumps at \$648.00 each has been awarded to F. L. Strong by the chief Quartermaster at Division Headquarters, Manila. The same authority also gave Fred. Wilson & Co. the contract for four portable scotch boilers at 1,570 each.

Artesian Wells.—For the year ended June 30, 1912, the artesian wells division of the Philippines bureau of public works, drilled 102 wells. Of this number 80 were successful and the remaining 22 were unsuccessful. The cause of failure in the majority of unsuccessful cases was due to encountering salt water at a depth of from 500 to 1,000 feet.

Engineering Amalgamation.—On June 18, Messrs. Howarth Erskine Ltd., and Messrs. Riley Hargreaves & Co., Ltd. of Singapore issued notices that the two firms had amalgamated under the name "United Engineers, Ltd."

Beet Sugar Refineries.—Several prominent Tokyo businessmen are organizing a beet sugar refinery in Koshu, Korea. The concern is capitalized at Yen 5,000,000. The promoters also contemplate founding another sugar refinery in Manchuria to work upon beets raised in Kirin province.

Agricultural College.—Bids for the projected electric light plant for the agricultural college at Los Banos were opened at the Philippines bureau of public works on July 4. The following bids were received:—Pacific Commercial Company £8,800 in 175 days; E. C. McCullough and Company £12,548 in 120 days; Frank L. Strong 10,400 in 150 days and Germann and Company £8,335 in 125 to 150 days.

CHINA

Canton Trams.—Frederick W. Cox, an American Engineer, has obtained a signed promise from the Governor-General of Kwangtung that the proposed tramway at Canton, which will cost about ten million dollars, will be financed with American capital.

Chinese Engineering Mining Co.—The extraordinary general meeting of this company to confirm the amalgamation with the Lanchow Mining Co., was held on June 13 in London. The proposal to go into liquidation and form a new company on the basis of the amalgamation was agreed to unanimously. The chairman (Mr. W. F. Turner) announced that in the liquidation a dividend of 1s. 6d. per share would be paid in respect of the profits of the company up to June 27, 1912.

Canton Cement Factory.—Owing to the large and increasing demand the Cement Factory at Canton has had to institute the system of night work twice a week.

Shanghai Dock and Engineering Co., Ltd.—The net profits of this company for the year ended April 30, 1912, amounted to Tls. 160,766.29. A dividend of Tls. 3 per share was declared, absorbing Tls. 165,600, and Tls. 4,166.29 was carried forward. Last year the dividend was Tls. 2½.

Sericulture in Korea.—The Government of Korea last year granted subsidies aggregating Y 13, 507 for the encouragement of sericulture. The results have been very satisfactory.

Yangtse Engineering Works.—When the revolution broke out the Yangtse Engineering Works had a contract from the Government for the building of several gunboats. The contract has been renewed, and Mr. Wong Kwong, the company's manager, arranged to go to Peking to discuss the financial arrangements with the Government.

Nagasaki Spinning and Weaving Co.—A meeting of the promoters of this company was held recently at Nagasaki, the capital required was estimated at one million yen, of which Y 35,000 would be used for purchase of land, Y 250,000 for buildings and Y 595,000 for plant. The annual receipts are estimated at Y 2,321,250 and the expenditure at Y 2,147,775 including Y 1,932,975 for raw material. The balance of Y 173,475 would represent a profit of 17.3 per cent. on the invested capital.

Hokkaido Colliery and Steamship Co.—The directors of this company being anxious to raise Y 6,000,000 for the improvement of the property asked the Mitsui and Co., one of the biggest shareholders to take up Y 2,350,000 of the loan. The firm had already lent Y 1,350,000 to the company and it declined to make further advances until they knew more of the real condition of the company from independent investigation. The directors of the company have consequently resigned and it is thought in some quarters that this will give an opportunity to Mitsui and Co. to secure control.

Salt Works in Korea.—The Korean Government's salt works at Kunsan and other places have proved fairly successful and it is now thought that the Korean product, owing to the cheapness of production and superior quality can compete with any important salt. At present about three hundred million *kin* is consumed in Korea annually, of which two hundred million *kin* is produced locally and the balance is imported from China, Manchuria and Formosa. As soon as international agreements permit a salt monopoly will be established.

SHIPPING

Pasig Steamer and Lighter Co.—Messrs. Warner, Barnes and Co. are interested in this company, which has been capitalized at P 100,000. It is organized to conduct a general freight and lighterage business.

Zamboanga Warehouse Co.—This company has applied for a charter to carry on a general shipping business. The capital stock is P 21,500.

Zambales Steamship Co.—Chinese residents of Olongapo and Subig have organized this company with a capital of P 20,000 to operate the steamer Balayan between those ports and Manila. The headquarters will be at Olongapo.

Motor Vessel from Hongkong.—Mr. Meischke-Smith, of the Asiatic Petroleum Co.,

Ld., London, has placed an order with the Tai-koo Dockyard Engineering Co., of Hongkong, for the building of the largest motor vessel which, so far, has been built outside of Europe, and Messrs. Olderup and Schluter, the representatives for the East of Messrs. J. and C. G. Bolinders, will supply the motor machinery. The principal dimensions are as follow:—Length, overall, 218 ft.; beam extreme, 32 ft.; and depth moulded, 9 ft. 6 in.

N.Y. K. fleet.—The Nippon Yusen Kaisha has recently bought two foreign steamers. One of these is a steel spar-deck steamer, the Hillcrag (late Bannockburn), 4,036 tons gross, built at Glasgow in 1908 by Messrs. Russell & Co. This vessel was beached near Dover in March, 1911, after a collision in the English Channel, and after having being refloated and repaired, was sold for about Y. 42,000 in September last to the Jetsam Shipping Co., of London, which has now sold her to the Japanese Company for about Y. 54,000. The other vessel is a steel 'tween-deck steamer, now being built by Messrs. Russell and Co., at Glasgow, to carry about 8,300 tons deadweight, and which has now changed ownership.

MINING

PHILIPPINE ISLANDS

Guamas Dredge Launched.—On July 1st the big dredge on the Guamas river was launched. The dredge is being installed by the New York Engineering Co. for the Philippine Exploration Co. which controls the property on the richest placer grounds in Paracale, situated on the Guamas river. The work of installation comprised the building of a railway from the coast to the side of the new dredge, the construction of a dam near tide water, another below the pit where the dredge was launched and another above as a sort of retaining wall. The dredge is 120 feet in length 40 foot beam and depth eight feet. Over 300,000 feet of timber was used in its construction. It was expected that the dredge would be in active operation within two months of the launch.

Bataan Coal Mine.—A new Company is to be organized to take over the affairs of the East Bataan coal mining company and to operate the mine for the benefit of the stockholders of the old company and the creditors of the organization. The new company has not as yet been organized, but all plans have been made for its formation. It is probable that Mr. Nolting will be the president of the new company, and that Colonel Harbord acting chief of the constabulary and A. T. Gillespie the broker will be on the board of directors. C. N. Orr the present manager of the mine will continue in his present capacity, he being a mining man of many years' experience in the United States. The present equipment with the apparatus and the mine is expected to be turning out 300 tons a day at the end of three months after starting. The capital of the new company is to be P50,000 for which bonds are to be issued.

Electrical Dredge.—A new electrically driven dredge has been purchased from Hongkong by H. E. Nelson for installation on the Mariquina River. It has a capacity of 1,000 cubic meters in 10 hours, lifting gravel from a depth of 24 feet at an angle of 45 degrees. The power will be supplied by the Manila Electric Railroad.

Hydraulic Gold Mining.—The Luzon Gold Company, which holds properties in Tayabas, Nueva Ecija, Rizal and on the headwaters of the tributaries of the Umrai River and Angelo River has introduced the hydraulic process. The plant now in operation consists of 300 yards of ditch flume and 60 yards of flume, delivering water to a penstock from which is taken a double line of hose carried

across the river by a suspension bridge. One hose is used as a bank head and the other a nozzle head. Further plants are to be installed.

Junction Mining Co.—A company bearing this name has been formed in Manila to carry on mining operations in Surigao district, Mindanao. The company has been incorporated for P200,000. The prospects are said to be most favourable.

Umeari Gold, Limited.—A New South Wales corporation organized to operate on the Umeari river, northern Luzon, has been given a license to do business in the islands. Wolfson and Wolfson are attorneys for the company.

CHINA

Tayeh Silver Mines.—Rich supplies-of-ore are accessible at the Government silver mines at Lungkoshan. Workings have been started in six different places and plans are being devised for smelting furnaces to be erected in the vicinity, and a railway is to be made either to the river or to Wuchang.

Coal near Changchun.—A Chinese discovered recently a coal mine at a village called Huashihing situated at the south of Changchun. He is desirous of working the mine on share capital, and is reported to have sent some agents to Shanghai for the purchase of machinery, etc.

Siberian Tin.—German capitalists with the co-operation of the St. Petersburg International Bank have formed a company to exploit tin mines in the Transbaikal-Nerchinsk district, three and a half miles from the station of Olovnyanka on the Transbaikal Railway.

Saghalien Coal.—The Duisky Coal mines in Saghalien are said to be the best in the whole Pacific region, both in quality of coal and wealth of deposits. The coal yields 71.01 per cent of coke and its heat productivity is given as 7,735.27 calories. It may compare with the best varieties of English or Scotch coal, being suitable not only as a steam raiser, but also for the coke it will yield for use in blast furnaces and for other metallurgical purposes.

Coke in Japan.—Owing to the limited supply of coke available from English and Germany the Japanese have established several special coke manufactories. Experiments have shown that the best coke is that produced from Kaiping coal dust. It costs about Y 13 a ton, while German coke cost Y 26 and English Y 24 a ton. The Kaiping coal dust is taken by rail from Tangshan to Chingwantao. The coal store at Chingwantao is connected with the wharf by two lines of railway, and steamers are enabled to take a load of 3,000 tons in twelve hours. About 541,810 tons are imported into Japan annually.

RAILWAYS

Kaiyuan-Taolu Light Railway.—As the outcome of a heated debate at the Fengtien Provisional Assembly the scheme for building a light rail line between Kaiyuan and Taolu was adopted in preference to the other plan of choosing Tiehling for the western terminus of the line. It was passed by a large majority that this light railway line should be extended further westward to Tungkiangkou, the river port on the Liao. The question of constructing another line between Taolu and Tiehling was left optional and permissible.

Military Lines in Kwangtung.—The Tutul of Canton, Hu, has decided to construct military railways to connect the provincial Capital with the surrounding districts to the east, west and

north. Lo Yi-chun has been appointed the chief surveyor to survey the lines.

Tientsin-Pukow Railway.—Its Southern and Northern Sections being connected, the Tientsin-Pukow Railway was opened to through traffic on the 21st ult. The time now required to go from Shanghai to Tientsin or vice versa is three days, but an express will run in the Autumn when the trip will take one day and a half.

Kirin-Chanchung Line.—It is estimated that nearly three million taels are necessary before this line can be brought into working order.

S.M.R. Co.—The South Manchurian Railway Co. management has issued to its shareholders a circular notice calling them to pay in the third instalment of Yen 40 per share of Yen 200 by October 1st next. This, coming, as it does in the track of the second instalment called up on June 1st last, will bring up the total instalments called up to Yen 120 per share, viz., Yen 12,000,000 out of the total sum of Yen 20,000,000 subscribed to by the shareholders.

Oil on Railways.—The Federated Malay States railways have commenced trials with a locomotive burning oil fuel. Experiments with oil fuel were carried out on the Siam States Railway some years ago, and proved successful. There are running on the Petchaburi line between Bangkok and Hua Hin eight locomotives using oil fuel.

Penang-Kedah.—Construction has started at the Bukit Uertajam end of this line in the Straits Settlements. It is anticipated the survey of the whole line will be shortly concluded.

Saigon-Korat.—The French authorities in Indo-China are doing their utmost to bring about a decision in favor of connecting Saigon with Korat by rail, but the conservative Siamese are strongly opposing the proposal. It is hoped that within ten years time the Siamese network of lines will be completed, when it is hoped the Trans-Persian line will permit of through connection between Paris and Saigon.

Pnompenh-Battambang.—There are two proposals to connect these places in the South of Indo-China one that a line should run to the north of the Great Lake, the other that one should run to the south. A road is now being built along the south of the lake and that route is favoured for a railway. A mineral region is being exploited between Pnompenh and Battambang by a syndicate formed by the Banque de l'Indo-China.

Chinese Tramway Scheme.—A company is being formed to construct a tramway in the Shanghai native city. The line will run from the foreign settlement to the native city, and the city service will include a line round the site of the city wall. The wall is now being demolished. It has been arranged to purchase the materials through the Shanghai office of Messrs. Siemens China Electrical Engineering Co.

Shanghai Tramways.—The returns of the Shanghai Tramways (Foreign Settlement) for the week ended July 10 are as under:—

	1912.	1911.
Effective receipts (after deducting loss by exchange)	\$ 15,065.80	\$ 12,145.66
Passengers carried	789,071	556,358
Car Miles run	54,647	45,148

The loss by exchange of subsidiary coinage for the week was equal to 25.36 per cent of the gross cash collected on the cars as compared with 23.40 per cent for the corresponding week last year.

German Railway Construction Co.—The Orenstein and Koppel-Arthur Aktiengesellschaft (for Railway construction especially the German colonies) for which Messrs. Beyn Meyer & Co. hold agencies has declared a dividend of 14 per cent as in 1910. The amount set aside for depreciation was increased from M. 790,000 to M. 1,760,000.

Chekiang Railway Debentures.—The general meeting of the shareholders of the Chekiang Railway held on June 11, passed a resolution for the flotation of debentures amounting to S.Y. 1,500,000. The debentures are to be issued at S.Y. 95 net with 5% or 5½% interest, and are secured with the receipts of the Hangchow-Chiahsing Railway and are redeemable in the course of 6 years.

The Shantung Railway.—The Shantung Railway Company of Berlin has declared a dividend of 6 per cent., as compared with 6½ per cent. for 1910. This reduction was expected, because the revolution in China has influenced the receipts. The profit shares (Genuss-scheine) receive m. 5 (1910, m. 7½). The receipts of the railway for the month of April, 1912, amounted to \$409,900 (Mexican), against \$354,000 in April, 1911, and the receipts for the first four months of the current year show a total of \$1,517,000 (Mexican), being an increase of \$276,000, or 22.24 per cent., on the corresponding period of the previous year.

Canton-Hankow Railway.—The final survey of the Wu-chang-Yochow section of the Canton-Hankow railway was begun on May 20. Two parties set out from headquarters, one in charge of Messrs. F. W. W. Valpy, Richards and Zandotti, the other under Messrs. M. R. Sinclair and Sandberg. The first party is working from Wu-chang, and will return to Hankow each evening while the work is close at hand. The second party went into camp about five miles from Wu-chang and is working southward from that point.

The remaining engineers, about twelve, will be sent out as soon as the necessary equipment arrives from Shanghai. The pegging out of the line to Yochow should soon be in full swing.

Kiakta-Kulun.—The negotiations for the proposed laying of the Kiakta-Kulun Railway having been brought to a satisfactory settlement, the work is expected to be commenced upon the completion of the construction of the Kiakta section of the Trans-Baikal Railway. The franchise for operating the proposed line has been transferred to the Russo-Asiatic Bank.

Peking-Hankow Railway Receipts.—The receipt in March from passenger fares on the Peking-Hankow line amounts to \$225,732.35, and from freight \$744,359.80. The total receipt for March amounts therefore to 970,082.21. For the first ten days in April last the total passenger receipt was \$97,115.19, and freight receipt \$281,715.19, while for the corresponding period in March last the passenger and freight receipts were \$42,632.05 and 214,717.36 respectively. A glance at these figures will show that we have a very bright and promising future for all our railways says the "Peking Daily News."

Kowloon Railway Terminus.—The Hongkong government has made an extensive purchase of land for a railway terminus. It has closed a deal for the land of the Kowloon Land Reclamation Company and the property of the Hongkong and Kowloon Wharf and Godown Company, and will pay for the two the sum of \$1,500,000.

This deal settles a question that has been hanging fire in Hongkong for many months. The Hongkong and Kowloon wharf and godown company owns the land immediately contiguous to the present temporary terminal and the Reclamation company, organized several years ago, purchased land in Kowloon reclaimed by the government, and is again selling it back to

the government. The plans for the terminal call for extensive shops and sidings in Kowloon.

Proposed Railway from Chaochowfu to Hweichowfu. The consulate in its annual trade review in Daily Consular and Trade Reports for December 22, 1911, reported that a railway line from Chaochowfu, a prefectural city about 25 miles northwest of Swatow and connected with it by rail to Hweichowfu, another prefectural city, about 60 miles northwest of Kowloon (Hongkong), was under discussion. The recent revolutionary activity throughout the Province caused this, together with many other projects, to be temporarily abandoned, but, according to the Canton press (vernacular), the matter is being taken up again. It is reported that at a meeting of Hweichow and Chaochow merchants the following preliminary regulations for the proposed company were accepted:

1. That the name of the company should be the Merchants Hwei-Chao Railway Co. (Ltd.)
2. The length of the line shall be 246 miles (English), which will be divided into four sections as follows: First section, Chichshih Bay to Hweichow; second section, Hweichow to Haifung; third section, Haifung to Puning; fourth section, Puning to Chaochow.
3. The capital shall be \$20,000,000 Mexican (about \$9,100,000), to be divided into 4,000,000 shares.
4. The shares will be of three classes, namely, (a) 30,000 founders' shares, (b) 500,000 preferred shares, (c) balance ordinary shares.

Should this line materialize, it is reasonable to suppose that an extension will be made from Hweichowfu to connect with the railroad line into Canton. The prospects for raising so large a sum as \$9,100,000 locally are not bright at present. So far as I can learn no survey of the route has been made, but there are few, if any, geographical difficulties. Chichshih Bay is on the coast about midway between Swatow and Hongkong. It is not open to trade, but is reported to be a good harbor. There was some talk of fortifying it as a naval base last year.

DOWNIE DEEP WELL PUMPS

The Keystone Driller Company, of Beaver Falls, Pa., U.S.A. has issued a tenth edition of its catalog on Downie Deep Well Pumps. In addition to their world wide reputation as the leading drilling machine manufacturers of America, this company is securing equal fame for their deep well pumps. These pumps are entirely independent of the well are suspended from the top; may be withdrawn at any time without disturbing the well, and all parts are always accessible for repairs. They are constructed on the principle that "anything worth doing is worth doing well."

Catalogue No. 6 sets forth the construction and operation of the pumps so clearly that any good mechanic should be able to install any of them.

SCHERZER ROLLING LIFT BRIDGES

Recent orders of the Scherzer Rolling Lift Bridge Company show a substantial and continued growth of business, and include many notable foreign orders, among which are a double track railway and combined highway bridge for the Great Central Railway, England, across the Trent River, having a movable span of 160 feet and a width of 53 feet 6 inches out to out. This bridge will be the widest and heaviest movable bridge yet constructed in Great Britain. Two Scherzer Rolling Lift Bridges have recently been completed for the Dublin Port and Docks Board at Dublin, Ireland, and a large railway and highway Scherzer Rolling Lift Bridge is nearing completion for the Swansea Harbour Trust at Swansea, Wales. The very large Scherzer Rolling Lift Bridge under construction

across the Nile River at Cairo, Egypt, is rapidly nearing completion and is expected to be in service within a few months. The Buenos Ayres Great Southern Railway Company have recently placed under construction the fourth Scherzer Rolling Lift Bridge in the process of modernizing and extending their terminal facilities at Buenos Ayres. The South Indian Railway Company in the process of extending their line toward the Island of Ceylon are constructing a double leaf Scherzer Rolling Lift Bridge having a movable span of 225 feet.

Within the United States and Canada more than one hundred and fifty Scherzer Rolling Lift Bridges have been constructed and placed under construction. The more recent railroad bridges placed under construction include a double track bridge for the Central Railroad Company of New Jersey, a double track bridge for the New York and Long Branch Railroad Company, and bridges for the Southern Railway Company, Savannah, The Atlantic Coast Line, Navassa, North Carolina, Arkansas Harbour Terminal Railway, Wildwood and Delaware Bay Short Line, the Canadian Pacific Railway at Fort William, Ontario, the Canadian Northern Railway across Salmon River and another across Rideau Canal.

The recent orders for electric railway and highway bridges have been especially numerous, including some very large and wide structures notably a double leaf structure at Toledo, Ohio, having a movable span of 211 feet center to center of bearings and a width of 70 feet; others at Lynn, Massachusetts; Huron, Ohio; Troy, Ohio; Minster, Ohio; Sagamore, Massachusetts; East Chicago, Indiana, Kimberly, Wisconsin.

All of these structures are designed by the Scherzer Rolling Lift Bridge Company, having main offices in the Monadnock Building, Chicago.

RESTORATION OF TELEPHONE SERVICE IN 98 HOURS

CENTRAL OFFICE IN KANSAS CITY TOTAL LOSS
AFTER FIRE

The Missouri and Kansas Telephone Company's Fairmount Exchange at Kansas City, Missouri, was completely destroyed, on Sunday, October 22nd at 3 A.M., by a fire which is believed to have been caused by an explosion of gas in the house adjoining that in which the central office was located. The telephone company at once communicated with the Western Electric Company and the work of restoring service to the subscribers was begun at 9.00 o'clock of the same morning, when a dozen men from the electric company's local installing force appeared upon the scene.

The Hawthorne factory of the Western Electric Company was called upon by long distance telephone to make a hurry-up shipment, and responded by sending forward the necessary apparatus by express the evening of the day on which the fire occurred, thus supplementing without delay the work which was being done by the local house in rushing material to the building in which the new exchanged was to be housed.

The new switchboard equipment consisted of several sections from the telephone company's stock, and some from an addition which was to be installed at the Rosedale Exchange, on account of the increasing business in that district. Twenty-six installers reported for work on Monday morning, October 23rd, and from that time until the new board was cut in service at 5.00 A.M. October 26th, with a full equipment of 800 subscribers' lines, a day and night crew were at work continuously.

Taking into consideration the fact that the work was done under high speed conditions, in order that the subscribers might not be inconvenienced for an extended period, it is worthy of note that the trouble reports issued as a matter of routine by the telephone company indicate that the work of the Western Electric Company's installing force was so well done that a minimum of trouble was experienced after the new equipment was cut into service.